Morton International Inc.

Pre-design Investigation Workplan
Ventron/Velsicol Superfund Site, Operable Unit 1
Wood-Ridge and Carlstadt, New Jersey`

January 12, 2007

PARSONS

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Prepared for:
Morton International Inc.

Prepared by:
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for

Ventron/Velsicol Superfund Site Operable Unit 1

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(EPA No. NJD980529879)

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List of Acronyms and Abbreviations

AHA	Activity Hazard Analysis
ASTM	American Society of Testing Materials
bgs	Below ground surface
CEA	Classification Exception Area
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CLP	Contract Laboratory Program
cm/sec	Centimeter per second
COC	Chain of Custody
CRG	Corporate Remediation Group
CVAA	Cold Vapor Atomic Absorption
DAR	Data Acceptability Review
DOT	Department of Transportation
DQO's	Data Quality Objectives
DTW	Depth to Water
DUA	Data Usability Assessment
EDD	Electronic Data Deliverable
EDSA	Environmental Data Submittal Application Checking
EPA	Environmental Protection Agency
FS	Feasibility Study
FSPM	Field Sampling
FSPM	Field Sampling Procedures Manual
GC/MS	Gas Chromatography/Mass Spectrometry
GIS	Geographic Information Systems
HASP	Health and Safety Plan
ICB	Initial Calibration Blank
ICV	Initial Calibration Verification
LCSs	Laboratory Control Samples
LD	Laboratory Duplicate
LIMS	Laboratory Information Management System
MDL	Method Detection Limit
mg/kg	Milligram per kilogram
MS	Matrix Spike
MSD	Matrix Spike Duplicate
msl	Mean Sea Level
MW	Monitoring Well
NIST	National Institute of Standards and Technology
NJDEP	New Jersey Department of Environmental Protection
NRDCSCC	Non-Residential Direct Contact Soil Cleanup Criteria
OU-1	Operable Unit 1
PARCC	Precision, Accuracy, Representativeness, Comparability and Completeness
PID	Photo Ionization Detector

List of Acronyms and Abbreviations (cont.)

PQL	Practical Quantitation Limits
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RAS	Routine Analytical Services
RAW	Remedial Action Workplan
RDCSCC	Residential Direct Contact Soil Cleanup Criteria
RI	Remedial Investigation
ROD	Record of Decision
RPD	Relative Percent Difference
SHARP	Safety, Health, and Risk Program
SOPs	Standard Operating Procedures
SRWM	Site Remediation and Waste Management
STL	Severn Trent Laboratories
SVOC	Semi Volatile Organic Compounds
TAL	Total Analyte List
TCL	Total Compound List
USCS	Unified Soil Classification System
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds
WRA	Well Restriction Area
XRF	X-Ray Fluorescence

Section 1 – Introduction

1.1. Intent of document

Morton International, Inc. retained Parsons to implement the preferred remedial measures at the Ventron/Velsicol Superfund Site Operable Unit 1 (Site). The selected remedial measures are presented in the Record of Decision (ROD), signed on October 30, 2006.

The intent of this pre-design workplan is to present the investigation program that will be performed to support the design of the selected remedies. The workplan is based on information from previous investigations performed during the remedial investigation activities as presented in Section 1.4. Based on the conditions and findings of the pre-design investigation program, additional investigations may be recommended at a later time to support the design. Recommended additional investigations will be issued through amendments to the document after approval by Morton International, Inc..

The pre-design investigation program is being performed concurrently with the preparation of the Remedial Action Workplan (RAW). Due to the schedule for submittal of the RAW to the New Jersey Department of Environmental Protection (NJDEP), the information collected as part of the pre-design investigation will be submitted under a separate cover and not incorporated into the RAW.

1.2. Site Background

The Site, described as OU-1 in the ROD, is divided into three areas consisting of a “developed” area, an “undeveloped” area, and an “off-site” area. The Site is located in the boroughs of Wood-Ridge and Carlstadt, Bergen County, New Jersey, as shown in **Figure 1**.

The developed area is approximately 7 acres in size and is the northernmost portion of the Site. Two active warehouses, referred to as the Wolf Warehouse and the U.S. Life Warehouse, are located on this portion. The former mercury processing facility was located on the area of the “Site” that is now occupied by these warehouses.

The undeveloped area is approximately 19 acres of land that were filled but not developed that are located generally south of the developed area of the Site. This portion of the Site is bordered to the north by the railroad track, to the south by Diamond Shamrock/Henkel Ditch (north), and to the east by Berry’s Creek.

The off-site portion consists of the following properties: the Blum Property, the Prince Packing property, the EJB property, the Lin-Mor property, Ethel Boulevard, and the Norfolk Southern Railroad. The Borough of Wood-Ridge owns Ethel Boulevard.

1.3 Regulatory Status

Regulatory oversight at the Site is being led by the NJDEP with support from the U.S. Environmental Protection Agency (EPA). The NJDEP issued a Record of Decision (ROD) for the Site on October 30, 2006. The selected remedy consists of two major components (1) ground water and (2) soil, which are presented below. Morton International, Inc. is presently preparing a RAW for the Site that will outline the approach to complete the remedial action.

1.4 Selected Remedy

The ROD documents the selection by the NJDEP of the remedial action for the Site in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).

The selected remedy represents the comprehensive remedial action for the Site, and addresses ground water and soil contamination. As presented in the ROD, the components of the selected remedy consist of the following:

<u>Ground Water Component</u>

- A vertical hydraulic barrier system will be installed to serve as a physical barrier to ground water flow and to encapsulate the areas of highest mercury concentrations under the Wolf Warehouse.

- Soil (with mercury concentrations below 620 mg/kg) generated from the installation of the hydraulic barrier (approximately 1,650 cubic yards) will be placed under the cap in the undeveloped area.

- Ground water use restrictions will be placed on the extent of the ground water contamination plume in the form of a Classification Exception Area and a Well Restriction Area to restrict use of contaminated ground water.

- Ground water monitoring will be conducted to determine if hydraulic controls within the barrier are required. If required, hydraulic controls will be implemented. Ground water monitoring will also be conducted to ensure the hydraulic barrier is effective.

<u>Soil Component</u>

- Excavation of all mercury-contaminated soil above 620 milligrams per kilogram (mg/kg) (approximately 7,150 cubic yards of soil) and offsite disposal of that soil, subsequent to any necessary treatment.

- Excavation of site-related contaminants on the Lin-Mor property to the NJDEP Residential Direct Contact Soil Cleanup Criteria. If the property owners of Lin-Mor agree to the placement of a deed notice, then excavation to the NJDEP Residential Direct Contact Soil Cleanup Criteria will not be required; however, a deed notice will be required.

- Capping areas and/or maintenance of the existing caps (i.e., parking lots and building foundations) with contamination in soil above the NJDEP Non-Residential Direct Contact Soil Cleanup Criteria.

- Excavation of soil within the 55-foot buffer area adjacent to Berry's Creek, the Diamond Shamrock/Henkel (north) Ditch, and the West Ditch; that soil may be placed under the cap in the undeveloped area. Certified clean fill will be placed in the buffer areas and native vegetation and erosion controls will be installed.

- Contaminated soil will be excavated from West Ditch to promote proper drainage and prevent transport of contamination to downstream areas. Specific details of the excavation depth, liner design and installation (if necessary), depth of certified clean fill placed into the ditch, and soil management will be determined during the design phase of the project.

- The drain line within the undeveloped area will be located and removed (if it exists) before installation of the cap.

- Deed notices will be required on all properties with contaminated soil exceeding the NJDEP Residential Direct Contact Soil Cleanup Criteria. If a deed notice(s) cannot be negotiated with a property owner(s), then all soil contamination above NJDEP Residential Direct Contact Soil Cleanup Criteria must be removed on that particular property or properties.

- To ensure the remedy is protective of surface water, monitoring of contaminant flux from ground water to surface water and sediment will occur.

1.5 Previous Investigations

Previous investigations and documents for the Site that were reviewed in developing this workplan include the following:

- CH2MHILL, "Feasibility Study Report, Operable Unit-1, Ventron/Velsicol Superfund Site, Wood-Ridge/Carlstadt, New Jersey", April 2006.

- Exponent, "Remedial Investigation Report for the Ventron/Velsicol Site, Wood-Ridge/Carlstadt, New Jersey", June 2004.

- Exponent, On-site and Off-site Soil Borehole installation, Exponent 2002.

- Exponent, Phase IA ground water monitoring well installations, Exponent 1999.

- Exponent, Phase IA Test Pit excavation program, Exponent 1998.

- NJDEP, Monitoring Well and Piezometer installation, NJDEP 1990 and 1991.

- Joseph S. Ward, Inc., “Report of Soils and Foundation Investigation, Woodridge Development, Woodridge/Carlstadt, New Jersey”, January 1975.

- Joseph S. Ward, Inc., “Report on Soils Investigation, Park Place East Development, Woodridge, New Jersey”, May 1974.

1.6 Workplan Organization

This workplan is organized into seven sections as follows:

- Section 1 – The intent of the document, site description, regulatory status, the selected remedy, and previous investigation activities;
- Section 2 – The pre-design investigation approach and assumptions;
- Section 3 – Field activities, associated water and soil sampling methods, required analyses, decontamination procedures and waste management practices;
- Section 4 – The Quality Control methods;
- Section 5 – The Health and Safety Plan;
- Section 6 – Reporting and Schedule; and
- Section 7 – References.

Section 2 – Pre-Design Investigation Approach

This section presents the pre-design investigation objectives, approach and assumptions for each remedial component stated in the ROD. **Table 2-1** summarizes the remedial components and the associated pre-design investigation activities aligned with each component. The methodology of each investigation component is presented in Section 3.

2.1 Vertical Hydraulic Barrier System

The remedial approach for this component includes the installation of a vertical hydraulic barrier around the perimeter of the Wolf Warehouse. It is assumed that the underlying gray to red-brown silt will serve as the confining layer and "key" material. Based on the existing information reviewed, the depth of the confining layer is assumed to be less than 30 feet below ground surface. The excavated material from the installation of the barrier system will be disposed under the site cap in the undeveloped area.

The pre-design investigation will consist of geotechnical soil borings along the proposed barrier wall alignment, as presented in Section 3 and shown in **Figure 2**. The purpose of the soil borings is to:

- Collect information on the subsurface stratigraphy and density of underlying soils using standard penetration testing;
- Identify the depth to the confining layer; and
- Collect soil samples for geotechnical laboratory testing.

The investigation will also include the review of existing utility plans, and a private utility contractor will be used to assist in identifying potential utilities that may cross the proposed barrier wall alignment.

Three test pits will also be excavated along or near the proposed barrier alignment, as presented in Section 3 and shown in **Figure 3**. The purpose of the test pits will be to:

- Evaluate different types of barrier wall technologies;
- Determine the level of difficulty excavating through the fill and the potential for "slurry loss";
- Identify the need for foundation support (such as underpinning) that may be necessary during the barrier wall installation and remedial excavation; and
- Obtain samples for compatibility testing.

Geotechnical laboratory testing will be performed on selected boring and test pit samples. The testing will include geotechnical index tests of various subsurface soils, hydraulic conductivity testing of the confining material, and barrier wall compatibility testing for evaluation of a soil-bentonite barrier wall.

2.2 Disposal of Soil from Hydraulic Barrier Wall Installation

The remedial approach for this element includes the removal of soil generated from the barrier wall installation and placement under the cap in the undeveloped area. It is assumed that this material will be suitable for disposal under the cap and will not require solidification/stabilization prior to placement. If geotechnical index tests indicate the need for solidification/stabilization a testing program will be developed as an addendum to this workplan.

As stated above, geotechnical index testing will be performed on selected boring and test pit samples to estimate the engineering properties of the material being placed under the cap.

2.3 Classification Exception Area (CEA) and Well Restriction Area (WRA)

The remedial approach for this element will restrict the use of contaminated ground water from the Site in the form of a CEA and WRA. The ground water restriction for this project is assumed to only address the site-related ground water contaminants specified in Table 6 of the ROD, which are arsenic, benzene, and mercury. Other contaminants may exceed New Jersey Ground water Remediation Standards; however, these will not be incorporated into the CEA as part of this remedial approach.

The CEA will be prepared using the existing ground water data from the RI. Morton International, Inc. has obtained a variance from NJDEP to use the existing RI ground water data, as it is was not collected within the latest 24 months, as required by the NJDEP Technical Requirements for Site Remediation (Chapter 7:26E).

2.4 Ground Water Monitoring

The pre-design investigation will consist of collecting one round of ground water elevations from the existing monitoring wells (MW-1 through MW-15) on the Site, as shown in Figure 2. Additionally, the ground water levels in the geotechnical borings and test pits along the barrier wall alignment will be recorded during drilling and excavation, respectively.

2.5 Excavation of all Mercury Contaminated Soil Above 620 mg/kg

The remedial approach for this element consists of excavating mercury-contaminated soils that are above the ground water table and that have concentrations greater than 620 mg/kg. Excavations are anticipated in both the undeveloped and developed areas of the Site. It is assumed that dewatering and excavation support systems will not be required since the excavations will be performed above the ground water table.

Pre-design investigation activities for mercury investigations in the developed area will consist of delineation borings in four areas (A, B, C, and D) as presented in Section 3 and shown on **Figure 4**. The objective will be to horizontally and vertically delineate the extent of soil with mercury concentrations above 620 mg/kg, to minimize disruptions of the warehouse operations during remedial activities. Currently there are four areas with samples that have mercury concentrations greater than 620 mg/kg that were identified in the FS. These areas consist of three relatively small square areas located around the U.S. Life Warehouse and one larger rectangular area located in front of the Wolf Warehouse. The delineation borings associated with the larger area will be spaced to provide for some of the confirmation samples thereby limiting the number of confirmation samples collected during excavation. The borings associated with the three other areas will be spaced to provide sufficient samples to more adequately define the limits of the excavations. It is assumed that confirmation sampling at these locations will be required during remedial excavations.

In the undeveloped area, there are four planned excavation areas identified in the FS. It is assumed that delineation activities will be performed during remedial construction; however, one or more of the geotechnical borings, as shown on **Figure 2**, will be drilled in the area of each potential excavation area to collect geotechnical information on the subsurface conditions.

2.6 Excavation on the Lin-Mor Property

The remedial approach for this element consists of either excavating soils to the NJDEP Residential Direct Contact Soil Cleanup Criteria or negotiating a deed restriction. It is presently assumed that no excavation will be required on the Lin-Mor Property. Morton International, Inc. is presently negotiating with the property owner for a deed restriction of the Site which would eliminate the need for excavation (and any investigations) on the Lin-Mor property. If a deed restriction is not obtained then an investigation may be required on the Lin-Mor property. Any investigation on this property will be addressed in an addendum to this workplan.

2.7 Capping / Maintenance of Existing Caps

The remedial approach for this element includes installing a single layer cap over the undeveloped property and EJB property. Additionally the existing foundations and asphalt parking lots of the U.S. Life and Wolf Warehouse will be repaired, as necessary, and maintained. It is assumed that the repairs will be limited to surface damage that can be observed during a visual inspection. Visual inspections will be limited to those areas of the foundation that are not obstructed by machinery or long term storage of materials.

The pre-design investigation for the single layer cap will consist of geotechnical soil borings in the undeveloped area as presented in Section 3 and shown in **Figure 2**. The purpose of the soil borings is to:

- Collect information on the subsurface stratigraphy and density of underlying soils using standard penetration testing; and,
- Collect soil samples for geotechnical laboratory testing.

Additionally, soil samples will be collected from hand-augers within the 55-foot buffer as presented in Section 3 and shown on **Figure 3**.

Geotechnical laboratory testing will be performed on selected boring and hand auger samples for the following:

- Index properties of the various subsurface soils and material from the 55-foot buffer and
- Consolidation properties of the meadow mat and underlying clay material.

The pre-design investigation for the existing caps will consist of a visual inspection of the parking lots and foundations pads for the above referenced properties. The objective of this task is to identify areas that may require upgrading to prevent direct contact and erosion of impacted soil, to minimize infiltration, promote positive drainage, or other conditions which may not be protective of direct contact.

2.8 Excavation of Soil within the 55-foot Buffer Area

The remedial approach for this element includes excavation of a 55-foot buffer area adjacent to Berry's Creek, the Diamond Shamrock/Henkel (north) Ditch, and the West Ditch. The excavation depth will be four feet or less throughout the 55-foot buffer area. The excavated material will be disposed of under the cap in the undeveloped area. At this time, it is assumed that this material will not require solidification / stabilization prior to placement under the cap. However, this will be evaluated as part of the design.

The pre-design investigation will include two days of hand augers along the buffer area, as presented in Section 3 and shown in Figure 3. It is assumed that five borings can be completed each day. The purpose is to identify the soil conditions; estimate the depth to water; and to perform geotechnical laboratory testing on selected samples. The purpose of the laboratory tests is to evaluate if the excavated material from the 55-foot buffer can be handled, placed and compacted in a manner that supports the cap, or if stabilization/solidification is necessary to maintain the integrity of the cap.

Additionally, a wetlands assessment will be performed as part of pre-design investigation to provide for the replacement of the appropriate wetland functions and values after the area is backfilled with clean fill. The objective of the wetlands assessment will be to determine the existing functions and values provided by the Site wetlands and floodplains. These functions and values may include, but are not limited to, one or more of the following: wildlife habitat, flow alteration, nutrient removal/transformation, sediment/toxicant retention, shoreline stabilization, ground water recharge, and aquatic diversity. The results of the assessment will be used as the basis for preparing a wetlands restoration plan for the Site.

2.9 Positive Drainage of West Ditch

The remedial approach for this element includes excavating soils in the West Ditch to create positive drainage. It is assumed that the soil may be contaminated and that gravity drainage can be achieved in the West Ditch.

The pre-design investigation will include a site survey of the drainage area contributing to the West Ditch as well as survey information of other drainage features (i.e., storm sewers, swales, etc.). The survey information will be used to evaluate gravity drainage of the West Ditch.

2.10 Location and Removal of Drain Line

The remedial approach for this element includes locating and removing the drain line (if it exists) in the undeveloped area. A review of historical documents indicated that there is a possible inactive drain line traversing the undeveloped area. The drain line is presently assumed to be intact. It is assumed that the drain line exists within the limits shown on the historical documents and is above the ground water table.

Two days of test pit excavations (or approximately seven test pits) are included as part of the pre-design investigation in the expected areas of the inactive drain line, as presented in Section 3 and shown in **Figure 3**. The test pits will concentrate in the areas where historical drawings suggest the outfall was located and near the historical on-site basin in the middle of the undeveloped area. The purpose of the test pits is to attempt to locate the pipe or visually observe where the pipe may have been located, such as gravel bedding. The location of the test pits have been selected based on historical drawings and aerial photographs. The test pits are located at the following locations:

- Near the potential former outfalls;
- Around the former on-site basin where the drain line was believed to have been located or near; and
- Locations from historical drawings which indicate similar locations of the drain line.

2.11 Deed Notices

The remedial approach for this element includes negotiating deed restrictions on several off-site properties. Morton International, Inc. is presently proceeding with negotiations to secure deed restrictions on these off-site properties that have soils that exceeding NJDEP RDCSCC. These properties include the following:

- Julius Blum & Company;
- Prince Packing;
- The former POTW; and.
- Jerbil (EJB Holding).

If deed restrictions are not obtained then investigation may be required at one or more of these properties. Investigations on these properties will be addressed in an addendum to this workplan.

2.12 Contaminant Flux

Once the remedial measures have been implemented at the Site, contaminant flux from the ground water to the surface water and sediments will be evaluated. The contaminant flux monitoring program will be developed during the design phase and no pre-design investigation activities are anticipated.

Section 3 – Field Sampling Plan

3.0 Introduction

This section presents the proposed components of the pre-design investigation at the Site, including the methodologies and analysis. The investigation components are as follows:

- Utility clearance / mark-out;
- Visual inspection of asphalt and building foundations;
- Site survey;
- Geotechnical soil borings;
- Mercury delineation borings in developed area;
- Hand augers;
- Test pits;
- Ground water measurements; and
- Wetland assessment.

Additionally, geotechnical and analytical laboratory testing will be performed as part of several of the above components. Pre-design investigation activities will occur on several properties in the developed and undeveloped area, as presented in **Table 3-1**.

3.1 Utility Clearance/Mark-Out

Utility clearance and mark-out activities will be performed to identify any existing utilities in the areas of the proposed subsurface investigations. Utility clearance will be performed for the following investigation activities:

- Geotechnical soil borings;
- Mercury delineation borings;
- Test pits; and
- Hand augers.

Additionally, the utility clearance will assist in the identification of potential utility conflicts along the proposed vertical barrier wall alignment.

3.1.1 Methodology

Parsons will review existing drawings to identify the location of active and inactive utilities that may conflict with the exploration locations. New Jersey One-Call will be notified of our intent to conduct subsurface activities at least 72 hours prior to the initiation of intrusive field tasks. The proposed locations of subsurface investigation will be marked in the field with stakes or white paint by Parsons or their drilling subcontractor. New Jersey One-Call will contact utility owners of record within the Site vicinity and notify them of our intent to conduct subsurface investigations in proximity to buried utilities. The utility owners of record, or their designated agents, will be expected to clearly mark the position of their utilities on the ground surface throughout the area designated for investigation.

Parsons will also subcontract a private utility locator to mark utilities on the private properties where subsurface activities will be performed. Parsons will review the investigation locations and modify them as necessary based on the mark-out.

In accordance with Parsons Safety, Health, and Risk Program (SHARP) manual and the pre-drilling protocol, the drilling subcontractor will use intrusive, non-destructive procedures (such as hand digging, vacuum excavation or air knifing) to a depth of 5 feet, at a minimum diameter or width equivalent to the outside dimensions of the down-hole equipment used to advance the boring, to identify any buried utility conduit that may have not been identified during other mark-outs. Depending on the subsurface conditions, vacuum excavation from a mobile or truck-mounted vacuum unit with a sealed container, instead of air knifing, will be performed.

The mercury delineation borings will not use air knifing or vacuum excavation to pre-clear the hole since environmental soil samples are required within the first 5 feet of the hole. In this situation and accordance with SHARP, Parsons will seek a waiver of the pre-drilling protocol from management as well as from Morton International, Inc..

3.1.2 Analysis

Material collected from these activities will be drummed, labeled, and transferred to a central storage area shown on **Figure 2** for disposal, as directed by Morton International, Inc.

3.2 Visual Inspection of Asphalt and Building Foundations

Parsons will perform a visual survey of the "currently capped area" that is anticipated to remain in place. This task is necessary to identify areas that may require upgrading to prevent direct contact and erosion of impacted soil, to minimize infiltration, and to promote positive drainage. The inspection will include the following areas:

- The parking lot of the EJB Holding;
- The building foundation and parking lot of the Lin-Mor Property;
- The building foundations and parking lots of the U.S. Life Warehouse and the Wolf Warehouse;
- The existing pavement of Ethel Boulevard; and,
- The existing gravel sub-base of the Norfolk Southern railroad property.

3.2.1 Methodology

The task will consist of a "walk through" by Parsons representative(s) to document the condition of the currently capped areas and observe surface drainage patterns. A “walk through” checklist will be completed at each property. An example checklist is included in **Appendix A.** Additionally, Parsons personnel may photo-document various conditions during the “walk through”.

3.2.2 Analysis

The inspection check-lists and photo log will be included in the pre-design investigation memorandum. There are no samples obtained as part of this task.

3.3 Site Survey

Parsons will perform a site survey to supplement the existing topographic information, field verify the existing survey information, and subsequently develop a base plan that will serve as the basis for the design drawings and construction quantity estimates. The survey will be performed by a New Jersey Registered Land Surveyor.

3.3.1 Methodology

The survey will include a topographical and planimetric survey of the developed and undeveloped areas, with a focus on Site features such as existing drainage swales/ditches, railroad tracks, buildings, above-grade utilities, manhole rims, inverts, building loading bay elevations, pipe inverts, and topography. In addition, the survey will obtain the location of the pre-design soil borings, test pits, visual inspection points, hand auger borings, and wetland flags. The survey will also obtain center line, top and bottom of creek slopes on both sides, and spot elevations on the undeveloped area at 55 feet and 100 feet away from the West Ditch and Diamond Shamrock/Henkel Ditch (north) every 100 linear feet along the alignments. Berry's Creek will be surveyed on the centerline, top and bottom of creek slopes on the undeveloped area (i.e., to the eastern property line in the creek).

The survey will be performed on the ground by conventional methods. The topographic contour interval will be one foot. Ground spot elevations will be shown to the nearest tenth of a foot. Building floor elevations, pavements, walls, curbs, rails drainage and sanitary structures will be shown to the nearest on hundredth of a foot. Elevations will be geo-referenced to the North American Vertical Datum of 1988. The horizontal datum will be the New Jersey State Plane Coordinate System NAD 1983.

3.4 Geotechnical Soil Borings

Parsons will drill geotechnical soil borings in the developed and undeveloped areas of the Site. The borings in the developed area will be along the proposed vertical barrier wall alignment and the borings in the undeveloped area will be within the limits of the proposed Site cap.

3.4.1 Methodology

A Parsons field representative will be present to record drilling activities, coordinate sample collection, and monitor the work area and the site as required by the HASP and air quality monitoring program. The data collected will include but not be limited to the following:

- Predetermined boring identification number;
- Location;
- Drilling subcontractor and method;

- Weather;
- Date;
- Depth to ground water;
- Soil classification of each sample; and,
- Standard penetration test N-value (blow count) for each sample.

A sample boring log is included in **Appendix A**. The borings will be drilled using mud rotary drilling methods. Excess soils and drilling mud will be placed in drums, labeled and transferred to a central storage pad prior to disposal as directed by Morton International, Inc.. The soil borings will be backfilled using tremie grout techniques. Each boring will be labeled and marked with a survey stake, and the boring locations will be surveyed.

Drilling and soil sampling equipment will be decontaminated in accordance with the procedures described in Section 3.10.1. All liquids generated by the decontamination process will be collected and contained for proper disposal as described in 3.10.2.

Developed Area Borings
Parsons will drill 11 soil borings (P-SB-1 through P-SB-11) along the proposed vertical barrier wall alignment, at locations shown on **Figure 2**. The borings locations were selected to result in a boring approximately every 100 to 150 feet along the barrier wall alignment. This frequency includes the existing borings that contain information on blow counts and that identify the key material. The soil borings will be drilled no more than 5 feet into the confining layer (i.e. gray to red-brown silt). Parsons and Morton International, Inc. will coordinate with the owners and tenants at the U.S. Life Warehouse and Wolf Warehouse to identify times that minimize the impact to business activities.

Undeveloped Area Borings
Parsons will drill eight soil borings (P-SB-12 through P-SB-19) in the undeveloped area within the limits of the proposed site cap, as shown on **Figure 2**. The borings are spaced at a frequency of approximately 1 boring per 2 acres of cap area. Where possible, the borings were also located adjacent to proposed mercury excavation areas. Four of the borings will be drilled to a depth of 50 feet below ground surface while the remaining borings will be drilled 5 feet into the gray to red-brown silt.

Prior to drilling the borings in the undeveloped area vegetation will be cleared to obtain access to each boring location. The vegetation will be removed and disposed of within the undeveloped area property.

3.4.2 Soil Boring Sampling and Analysis

During the drilling, split-spoon samples will be collected for soil characterization and geotechnical analysis. Soil samples will be collected at 2-foot intervals, continuously from the ground surface to the maximum depth along the proposed barrier wall alignment and at five-foot intervals in undeveloped area borings. Split-spoon samples (2-inch OD, 24-inch long) will be advanced using a 140-pound hammer falling 30-inches in accordance with ASTM D-1586. The soil will also be screened for volatile constituents using a photoionization detector (PID) and for mercury vapor using a portable Jerome® Model 411-X mercury vapor analyzer for health and safety purposes. Each soil sample will be described using the Burmister Soil Classification System and given a Unified Soil Classification System (USCS) designation in accordance with ASTM D2488. Sample classification guidelines are presented in **Appendix B**. The full recovery of each SPT sample will be collected in one-gallon plastic bags. Each sample will be labeled with the Site name, date, depth, boring location, and initials of representative.

Additionally, Shelby tube samples will be obtained in select borings from the meadow mat and the gray to red-brown silt in accordance with ASTM D1587. Shelby tube sampling guidelines are presented in **Appendix C**. In the developed area, approximately four Shelby tubes will be obtained to test the hydraulic conductivity of the confining layer in accordance with ASTM D5084. In the undeveloped area, approximately six Shelby tubes will be obtained (3 from the meadow mat and 3 from the red-brown silt) to estimate the consolidation properties in accordance with ASTM D2435.

One set of index tests will be performed on a selected sample from each boring. The index tests will consist of the following:

- Moisture Content (ASTM D2216);
- Unit weight (ASTM D4254);
- Grain Size (ASTM D422);
- Organic Content (ASTM D2474) – meadow mat samples only; and
- Atterberg Limits (ASTM D4318), if plasticity is noted in the sample.

The soil samples will be packaged and shipped to JLT Laboratories in Canonsburg, Pennsylvania. Shelby tube samples will be packaged to minimize disturbance to the sample during shipping. The extra bag samples will also be shipped to JLT Laboratories for the compatibility testing program.

The long-term performance of any type of barrier wall can be adversely affected by the surrounding ground water or soil chemistry. The subsurface conditions and geotechnical engineering properties along the vertical barrier wall alignment are not well defined. These conditions will be a significant factor in the type of technology (e.g., sheet pile wall, one-pass trenching wall, traditional excavated wall, etc.) used to construct the vertical barrier wall. Upon completion of the geotechnical soil borings, a compatibility testing program will be developed based on the potential barrier wall alternatives. One of the potential alternatives is a soil-bentonite barrier wall installed using slurry techniques or a one-pass trenching machine. During the pre-design investigation, soil samples will be collected and archived. If a soil-bentonite type wall is selected, these samples will be used as part of the compatibility testing.

3.5 Mercury Delineation Borings in Developed Area

Parsons will drill soil borings in the developed area to further delineate the soils in which mercury concentrations exceed 620 mg/kg. Hollow stem auger methods will be used to advance the borings. For the purposes of the delineation investigation, the four areas where soil borings will be performed have been identified as Areas A, B, C and D as shown on **Figure 4**.

Note that soils in the undeveloped area are not part of the pre-design investigation workplan, however these soils above 620 mg/kg in this area will be excavated in accordance with the ROD without pre-sampling.

3.5.1 Methodology

Delineation in Areas A, B, and C will consist of soil borings drilled in a 20-foot grid pattern. This results in 3 to 4 borings per area. The borings will be centered on historical sample locations where mercury was measured above 620 mg/kg. The numbered grid nodes denote the order in which samples will be collected. If mercury concentrations in the soil samples exceed 620 mg/kg, additional borings offset in a 20-foot grid may be drilled.

Delineation in Area D will consist of soil borings identified as preliminary (solid dot) and secondary (open circle with dot). The approach will be to drill the preliminary borings first and then, based on the preliminary results, drill the secondary borings as necessary. The preliminary soil borings will be drilled in a grid pattern of 40-foot northwest-southeast spacing and 20-foot northeast-southwest spacing. The grids will be centered around the historical samples where mercury was measured above 620 mg/kg. The preliminary grid sampling will occur on the perimeter of the rectangular area along Ethel Boulevard on the north side of the Wolf and U.S. Life Warehouses. In addition, grid samples are planned at the ends of the rectangular area, at four locations within the rectangular area, and along the centerline of Ethel Boulevard (20 feet northeast of the planned rectangular excavation area).

The borings will be drilled at each grid node location using a hollow stem augers and standard split-spoon sampling methods. Prior to drilling and sampling at each location, the asphalt (or other surface material) will be removed using a hand auger, coring device, or jackhammer. At Areas A, B and C, the sampling will continue to a depth of 4.5-feet below the ground surface. At Area D, the sampling will be performed to a depth of 5.5-feet. Borings will be terminated if the ground water table is encountered shallower than the desired depth. The soil in the split-spoons will be visually inspected by a Parsons field representative and described using the Burmister Classification System. Drilling information, soil descriptions and monitoring data will be recorded on a soil boring log.

Excess soils and drilling cuttings will be placed in drums, labeled and transferred to a central storage pad prior to disposal as directed by Morton International, Inc.. The soil borings will be backfilled using tremie grout techniques. Each boring will be labeled and marked with a survey stake and the location surveyed. Where an asphalt surface was penetrated, a cold-patch asphalt material will be used to finish the surface completion.

Drilling and soil sampling equipment will be decontaminated in accordance with the procedures described in Section 3.10.1. All liquids generated by the decontamination process will be collected and contained for proper disposal as described in 3.10.2.

Soil with mercury concentrations in excess of 620 mg/kg will be transported off-site for appropriate disposal.

3.5.2 Analysis

Soil samples will be collected continuously from each borehole using a 2-foot long, 2-inch diameter split-spoon sampler in accordance with ASTM D1586. The soil will also be screened (in six inch intervals) for volatile constituents using a photoionization detector (PID) and for mercury vapor using a portable Jerome® Model 411-X mercury vapor analyzer for health and safety purposes and for total mercury as described below. Soil samples for mercury analysis will be collected from discrete six-inch intervals, homogenized, and placed in appropriate sample containers provided by STL Laboratories of Edison, New Jersey. Samples will be labeled in accordance with Morton International, Inc. sample nomenclature guidelines. A copy of these guildelines is presented in **Appendix D**. Selected samples will be archived at the laboratory and would be available for analysis if it was determined that initial samples did not delineate mercury above 620 mg/kg. A summary of the anticipated soil sampling program is included in the **Table 3-2**.

In addition, a subset of the total number of 6-inch soil samples collected for laboratory analysis (and for archiving) will be screened in the field for total mercury concentration using a portable x-ray fluorescence (XRF) analyzer [e.g., Niton (Thermo Electron), Innov-X (InnovXsystems), or similar]. Field screening methods will follow the manufacturers' specifications and applicable guidance in EPA Method 6200 - Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment. The field screening results will be compared to the laboratory analytical results to determine the degree of correlation of mercury concentrations between the two analysis methods. The correlation results will be used to determine the applicability of the field screening method (and appropriate safety factor) for use in providing real-time results for the planned excavations of soil containing mercury above 620 mg/kg.

Samples will be labeled, packaged, shipped under chain of custody to the analytical laboratory in accordance the procedures described in Section 4 of this workplan.

Select soil samples will be analyzed for total mercury in accordance with EPA SW-846 Method 7471A using cold vapor atomic absorption (CVAA) spectrophotometry (US EPA 1997). Samples not planned for initial laboratory analyses will be archived at the laboratory for up to 28 days (**Table 3-2**). A turn-around-time of two days will be requested for the initial samples (and subsequent archived samples) submitted for mercury analysis to allow for timely review of the results to determine if they successfully delineate concentrations greater than 620 mg/kg. If the results do not delineate the concentrations greater than 620 mg/kg, then a review of the archived samples will be conducted to determine which additional samples need laboratory analyses. If additional sampling locations are required, then they will be collected in the field and submitted for laboratory analyses. Depending on the analytical results at the array of numbered grid nodes, the delineation of final excavation areas could be smaller than those indicated in the FS (and referred to herein as Areas, A, B, C, and D).

3.6 Hand Augers

Parsons will perform two days of hand augers (P-HA-1 through P-HA-10) within the 55-foot buffer along the West Ditch, Diamond Shamrock/Henkel (north) Ditch and Berry's Creek. The hand augering will be performed at a frequency of approximately one every 200 to 250 linear feet as shown on **Figure 3**.

3.6.1 Methodology

The hand augers will be advanced to a depth of four feet below the existing ground surface using a stainless steel hand auger with a 5-foot extension bar. Soil samples will be collected in one-gallon plastic bags. Each sample will be labeled with the site name, date, depth, boring location, and initials of representative. The borings will be backfilled with soil cuttings. Each boring will be labeled and marked with a survey stake and the location surveyed. A Parsons representative will create a log at each hand auger location.

3.6.2 Soil Samples and Analysis

Composite soil samples will be collected from the auger cuttings and at visually observed stratigraphy breaks. Each soil sample will be described using the Burmister Soil Classification System and given a Unified Soil Classification System (USCS) designation in accordance with ASTM D2488.

Based on the material recovered, selected samples will be tested for the following:

- Moisture Content (ASTM D2216);
- Unit weight (ASTM D4254);
- Grain Size (ASTM D422);
- Organic Content (ASTM D2474); and
- Atterberg Limits (ASTM D4318), if plasticity is noted in the sample

The soil samples will be packaged and shipped to JLT laboratories.

The purpose of the laboratory tests is to preliminarily evaluate the suitability of the material from the 55-foot buffer to be excavated, handled, placed and compacted in a manner that will not adversely affect the long-term performance of the cap. Based on this preliminary evaluation, a solidification testing program may be required.

3.7 Test Pits

Parsons will excavate three test pits (P-TP-1 through P-TP-3) along the proposed vertical barrier wall alignment and seven test pits (P-TP-4 through P-TP-10) in the area of the suspected historical drain pipe in the undeveloped area. The locations of the test pits are shown on **Figure 3**.

3.7.1 Methodology

The test pits will be excavated using a backhoe excavator (i.e., rubber tired or tracked). Test pits will be terminated when the ground water table is encountered or once the bottom of fill has been observed, whichever is shallower. Care will be taken with the teeth on the excavator bucket to minimize the possibility of damaging any buried containers encountered. If a buried container is encountered, work will stop in the area and Morton International, Inc. will be notified. Work will proceed once a plan is developed and agreed upon by Parson and Morton International, Inc..

A Parsons field representative will log each test pit and take photographs to document the conditions. A sample test pit log is included in Appendix A. During excavation, air monitoring for gaseous mercury and organic vapor will be performed. The test pits will be backfilled with the excavated material and bucket compacted. In areas where asphalt was removed an asphalt patch will be installed.

Soil samples will only be collected from test pits along the vertical barrier wall alignment for the compatibility testing program. Soil samples will be collected in five-gallon plastic buckets.

3.7.2 Analysis

Composite samples will be collected from the test pits along the vertical barrier wall alignment. Two five-gallon buckets will be filled with material excavated from each test pit. Each bucket will be labeled with the test pit ID, date, initial of field representative, and depth obtained from. The buckets will be shipped to JLT Laboratories for potential compatibility testing.

3.8 Ground Water Measurements

Parsons will collect one round of ground water elevations from existing monitoring wells, MW-1 through MW-15 (15 wells) located in the developed and undeveloped areas. The locations of the wells are shown on **Figure 3**.

3.8.1 Methodology

An electronic water level meter (i.e. Solinst or equivalent) will be used to measure depth to water (DTW) levels in each of the monitoring wells. Prior to obtaining water measurements, each well cap will be opened and a head-space reading will be obtained using a PID and mercury vapor meter, and recorded. Subsequently, the water level probe will be lowered into the well, a DTW reading will be taken relative to the top of well casing (or designated measuring point elevation) as well as the time of reading and both will be recorded in the field log book. The DTW readings will be tabulated into a ground water elevation record summary report. A sample log is presented in Appendix A.

3.8.2 Analysis

No ground water samples or analyses are planned as part of the pre-design investigation program.

3.9 Wetland Assessment

Parsons will conduct a functional assessment of the existing wetlands and floodplains at the Site. This functional assessment will be used as the basis for the design of a wetland restoration plan that will be developed for the Site to provide for the replacement of the appropriate wetland functions and values.

3.9.1 Methodology

Parsons will conduct one site visit to collect the data necessary to obtain site-specific information regarding the soils, vegetation, hydrology, and wildlife habitat that are present at the Site. In addition, Parsons will review existing reports and publicly-available information concerning the Site and similar wetlands that are present in the New Jersey Meadowlands region. Such information may include wetland delineation reports and maps, correspondence with the U.S. Army Corps of Engineers and the NJDEP, aerial photographs, stream/tidal data, topographic maps, soil surveys and other items that may be relevant for describing the functions and values of the wetlands and floodplains.

3.9.2 Analysis

Parsons will prepare a memorandum report summarizing the results of the functional assessment including appropriate maps and other visuals to show the wetland boundaries and pertinent factors considered in the assessment (i.e., soils, vegetation, flow patterns, etc.). The report will highlight the primary functions and values of the Site wetlands and describe any secondary functions and values that might be enhanced as part of the wetlands restoration plan for the Site.

3.10 Decontamination and Waste Management

This section describes the general procedures for decontamination and management of the waste materials generated through the field investigation activities. The drilling subcontractor will establish a decontamination pad at a designated location within the undeveloped area.

3.10.1 Decontamination

All non-disposable equipment, materials, and tools will be thoroughly cleaned before each use to avoid cross-contamination or erroneous field measurements.

Large size equipment, drill rods, augers, backhoe bucket, and non-dedicated submersible pumps will be cleaned at the decontamination pad. Before initiating drilling at each delineation boring, the augers, cutting bits, samplers, drill steel and associated equipment will be thoroughly cleaned to prevent potential cross-contamination from the previous drilling location. Cleaning will be accomplished by flushing and wiping the components to remove all visible soils followed by a high-pressure steam wash and rinse at the decontamination pad. A portable steel drum (e.g., 55-gallon without a bottom bung) or other suitable tub may also be used to contain condensate from steam cleaning at selected locations. At the geotechnical soil boring locations the high pressure wash and rinse will not be required; however, equipment shall be substantially cleaned of soil prior to proceeding with a new boring location.

Small equipment, hand tools, and split-spoon samplers will be decontaminated away from the immediate drilling operations (e.g., at the back of the field vehicle) in specially prepared decontamination bins.

All equipment used for the collection of soil samples for chemical analyses (e.g., split-spoons) will be cleaned between each sampling location / interval in accordance with the eight-step procedure described below. The following steps will be used to decontaminate the sampling equipment:

1) wash with detergent (Alconox);
2) rinse with potable water;
3) rinse with distilled and deionized water;
4) rinse with rinse with 0.1N nitric acid (use for metals analyses only);
5) rinse with generous amounts of distilled and deionized water;
6) rinse with acetone;
7) allow to air dry; and
8) rinse with distilled and deionized water.

This decontamination process will be carried out over a container.

All equipment will be allowed to dry thoroughly in a dust-free environment. If the equipment is not to be used again immediately, it will be packaged and properly stored to protect it from dust and dirt. Clean sampling equipment will not be placed on the ground or on other contaminated surfaces following decontamination and prior to being used.

Additional decontamination information is provided in Section 4.5.1.

3.10.2 Waste Management:

As a result of the field activities, there will be a number of waste streams generated at the Site. These will include drill cuttings, drilling mud/liquids, waste materials produced by the decontamination procedures such as rinse liquids, solids, paper towels, gloves, and other materials. All decontamination rinsate, water and drilling mud generated during the drilling activities will be containerized in Department of Transportation (DOT)-approved 55-gallon drums (without bottom bungs) that will be sealed and labeled with the date, site address, and contents. The drums will be staged at a pre-approved location at the Site pending characterization and appropriate disposal by Morton International, Inc.. Morton International, Inc. will be listed as the generator of the waste and will sign all waste manifests. Characterization sampling parameters will depend on the disposal facility.

Section 4 - Quality Control

This section provides a description of QA/QC field samples and laboratory requirements, which provide a means to measure, quantify, and evaluate the data quality from this investigation. The quality control is consistent with the methods presented in the Remedial Investigation Report. This section serves as the Quality Assurance Project Plan (QAPP) for the pre-design investigation.

4.1 Data Quality

The objective of establishing and defining quality assurance / quality control (QA/QC) procedures is to obtain samples that yield data of consistent quality. Data quality is provided for by adhering to specified procedures described in Section 3 for decontamination of sampling equipment, performing equipment calibration and maintenance, documenting proper sample identification and field documentation, as well as proper sample handling and chain-of-custody record keeping. **Table 4-1** includes a summary of the estimated number of samples anticipated to be collected during the project and data quality objectives. The constituents of interest and associated remediation goals for soil sampling are listed in **Table 4-2**. A summary of the QC sample frequency planned is provided in **Table 4-3**. Preservation, container, and holding-time requirements for the parameters to be analyzed are listed in **Table 4-4**.

4.2 Data Quality Objectives

A clear definition of data objectives and procedures is required to effectively use the data generated during field activities of the remedial action. This is accomplished through the establishment of Data Quality Objectives (DQOs), which relate the extent and quality of data to be gathered in the remedial action to their ultimate objectives. DQOs for remedial action activities are provided in **Table 4-1**.

Different analytical levels are available for a site investigation depending on the DQOs of the program. The analytical levels, as defined by the EPA *Data Quality Objectives for Remedial Response Activities*, (EPA, 1987) include the following:

Level I - Field screening or analysis using portable instruments. Results are often not compound specific and not quantitative; but results are available in real-time. It is the least costly of the analytical options.

Level II - Field analyses using more sophisticated portable analytical instruments than Level I. The instruments may be set up in a mobile laboratory onsite. There is a wide range in the quality of data that can be generated. It depends on the use of suitable calibration standards, reference materials, and sample preparation equipment; and it depends on the training of the operator. Results are available in real-time or several hours.

Level III - All analyses performed in an off-site analytical laboratory. Level III analyses use or are based upon approved or routinely accepted analytical methodologies but do not usually utilize the detailed validation or documentation procedures of DQO Level IV analysis.

Level IV - EPA Contract Laboratory Program (CLP), Routine Analytical Services (RAS), or equivalent. All analyses are performed in an off-site laboratory following CLP or equivalent EPA protocols. Level IV analyses require rigorous QA/QC procedures and documentation.

Level V - Analysis by nonstandard methods. All analyses are performed in an off-site analytical laboratory. Method development or method modifications may be required for specific constituents or detection limits.

The project-specific DQO levels that will apply for various parts of the project are detailed in **Table 4-1**.

The purpose of the QA/QC program is to develop, document, and implement procedures for producing and providing field measurements, sampling, and analytical testing data of known quality that meet or exceed quality standards consistent with the intended use of the information.

This QC Program:

- Establishes the data quality goals through the DQO process, and
- Sets guidelines for meeting these goals through the Precision, Accuracy, Representativeness, Comparability, and Completeness (PARCC) parameters.

The DQO-level process provides a system for selecting methods, level of QC, and documentation appropriate for the project based on intended use of the data. Setting PARCC guidelines for the data is necessary for subsequent assessment of actual data quality relative to accepted standards. Specific PARCC objectives are based on the analytical methodologies used. A description of the specific calculations for measuring data quality relative to the guidelines detailed below is presented in Section 4.9.1.

DQOs are based on the concept that different data uses may require varying levels of data quality. Project DQOs are established based on the overall project objectives and types of decisions that will be made based on the data collected. DQOs are defined with respect to the types, numbers, and locations of samples that will be collected, and the quality assurance levels associated with the analysis. The guidance document *Data Quality Objectives: Development Guidance for Uncontrolled Hazardous Waste Site Remedial Response Activities* (EPA, 1987) has been used as basis to determine the analytical methodologies and data quality required to obtain confidence levels appropriate for the intended data use.

While most data collected will be considered DQO Levels I and III, some data from all DQO levels may be collected throughout the project. The rationale of applying DQO levels to analyses based on the types of decisions arising from those analyses is summarized below.

DQO Level I and II data are comprised of field data collected at the Site including: the screening of soil, air, and water for organic vapors using a photoionization detector and/or a flame ionization detector, water levels; and flow rates.

These data will be used to monitor the health and safety of field personnel, to assist in choosing sampling locations, and to assist in determining potential remedial alternatives. Field analysis and sampling methodologies are described in Section 3.

DQO Levels III and IV will include all samples collected for laboratory analyses. These analyses will be performed following standard EPA methods as applicable at New Jersey certified laboratories. Analytical methods to be followed are discussed in this section. Parameter remediation goals are listed in **Tables 4-2**. Analytical data will have standard detection limits and documentation suitable for characterization of the soil at the Site, and also for evaluation of potential remedial alternatives.

DQO Level V data are expected to be limited to analytical data needed for ecological risk assessments. These data may require specialized analytical methods such as acid volatile sulfide/simultaneously extracted metals and determination of selected organic and inorganic constituents at low detection limits.

Changes from original documents, procedures, and specifications are expected. Change does not necessarily imply a nonconformance with the work, but simply means that original plans may need alterations because of information or events that occur during the execution phase of the project. However, changes need to be documented according to the corrective action procedure described in Section 4.10.

4.3 Sample Collection

4.3.1 Field Screening Procedures

The onsite screening data generated using analytical and geotechnical techniques are an essential part of performing the remedial action. Because it is essential that valid and representative data are obtained during this process, it is important that proper equipment and analytical methods be used. The following analyses are anticipated during the course of the investigation:

I. Determination of Health and Safety parameters using portable gas detectors:
- Explosive atmosphere/oxygen content;
- Total organic vapor content via photoionization or flame ionization detector;
- Specific gas detectors (sulfur, methane, etc.);
- Noise level; and
- Dust level.

II. Determination of relative measure of total organic vapor for subsurface soil sample selection:
- Soil headspace organic vapor content via photoionization and flame ionization detectors

IV. Determination of total mercury concentration using a portable x-ray fluorescence (XRF) analyzer [e.g., Niton (Thermo Electron), Innov-X (InnovXsystems), or similar].

4.3.2 Sampling Procedures

All soil sampling activities will be performed in strict accordance with EPA and NJDEP guidelines, including collection procedures, decontamination of equipment, and sample handling and preservation. The field methods that will be used for this project are summarized in **Table 4-1**. Specific details on health and safety monitoring are provided in the Health and Safety Plan. Collection methods and preservation requirements for each analyte are listed in **Tables 4-1 and 4-4**.

4.3.3 Sample Analysis

Samples will be analyzed by an off-site laboratory in accordance with the EPA SW-846 methods. The corresponding analytical parameters are listed in **Tables 4-2**. A listing of the specific SW-846 analytical methods and sample collection requirements are provided in **Table 4-1**. The reporting/quantitation limits are provided in **Table 4-5**. Additional guidance is provided below.

Parameters will be analyzed according to analytical procedures set forth in EPA SW-846 (EPA, 1986b). Samples that have significant matrix interference may require specialized cleanup procedures and re-analysis in order to eliminate the interference and permit analysis to proceed with a reporting limit at or closer to the quantitation limit. The laboratory is expected to report any cases of matrix interference that cause elevated reporting limits without positive results for target analytes. Consideration for specialized methods will be given, based on the magnitude of elevated reporting limits, critical nature of the sampling points, availability of analytical options, and relative chance of successfully obtaining improved information.

Samples will be analyzed for the parameters as presented in **Table 4-2**. Analyte lists will be clearly indicated as such in the COC. The analyte list does not impact the method used. However only the requested analytes are subject to method requirements such as calibration.

Laboratories will maintain on file current MDL studies to demonstrate their ability to meet or exceed the recommended reporting limits. Laboratories must perform MDL studies on an annual basis (depending on the method) to demonstrate that it can meet or exceed the required project-specific limits. The EPA defines the MDL to be "the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero." The EPA procedure used for establishing MDLs is described in Appendix B to Part 136 "Definition and Procedure for the Determination of the Method Detection Limit - Revision 1.11," (40 CFR 136, 1986). In addition, the laboratory may establish laboratory-specific reporting limits or practical quantitation limits (PQLs) that are verified by the MDL studies and included on the laboratory's analytical reports.

4.4 Sample Custody

An essential part of any sampling/analytical program is the ability to document sample history. Sample custody procedures establish the documentation and control necessary to identify and trace a sample from collection through final analysis and reporting. Sample custody procedures are designed to provide documentation of collection, preparation, handling, storage, and shipment of all collected samples. A sample is under custody if it is:

- In one's actual possession;
- In view after being in physical possession;
- Locked after having been in physical possession; and
- In a secure area, restricted to authorized personnel.

Documentation associated with the sample custody procedures include, but are not limited to, sample labels to prevent sample misidentification, container seals to prevent unauthorized access to samples, and COC forms to document proper preservation and handling procedures from collection through laboratory receipt.

All documentation procedures will utilize standard, evidentiary protocols as follows:

- Only preformatted forms or sequentially numbered, bound log books will be utilized for collection of information;
- All entries on preformatted forms will be completed; blanks are not acceptable; lines may be marked “NA" or lined out in cases where information is unavailable or inapplicable;
- All entries will be made in waterproof ink with no erasures;
- A single stroke will be used to cross out incorrect information; corrections will be dated and initialed;
- Forms will be filled out in a legible manner and will be signed and dated by the person completing the form;
- Following completion of the form, any trailing blank space will be crossed out to prevent addition of information at a later date; the crossed-out spaces will be initialed by the person completing the form; and
- Original forms (with the exception of COC forms) will be maintained in the project files; original COC forms will be shipped to the laboratory with carbonless copies maintained on file.

Sample custody protocols, both field custody procedures and laboratory custody procedures, are described below.

4.4.1 Field Samples

The field team is responsible for maintaining and documenting sample custody from collection until shipment under custody seal protection to the off-site laboratory. The Parsons Field Team Leader is primarily responsible for ensuring that the field team adheres to proper custody and documentation procedures during all sample collection operations. The Parsons QA Officer is responsible for auditing custody procedures.

The following procedures, or equivalent, will be used for sample tracking and field activities:

- Field or sample collection logs;
- Sample identification and labeling;
- Sample COC form; and
- Sample shipment.

Original sample information will be collected in the field by a field team member who will record it into either field log books or sample collection logs as appropriate for the information. Examples of representative sample collection logs for various types of samples (such as soil boring samples) are included in **Appendix A**. The sample collection log and field log books will be used to record a variety of information, including date, start and end time of activities, names of all sampling team members, weather conditions, sample location, equipment used to collect the sample, depth of sample, time of collection, sample description, sample identification number, and the volume and number of containers. All original sample collection forms will be maintained on file. Portions of the sample collection log information may be transcribed onto the COC forms prior to shipment of samples.

4.4.2 Sample Labeling - Field Generated Samples

Sample labels will be checked against field log books and chain-of-custody forms prior to shipment to the laboratory. Any discrepancies will be corrected by crossing out the wrong text or identification with a single line, initialing the mistake, and writing the correction legibly.

All sample containers will be labeled clearly and all labels will be secured with clear tape to prevent separation of labels from sample containers or obscuring of information.

Sample labels will conform to Morton International, Inc. standards as defined in the Corporate Remediation Group (CRG) website. The following information will be included on sample labels affixed to field sample containers:

- Destination Laboratory (e.g., STL Edison) ;
- Site Identification—the site name and location or a unique project number which identifies the Site. The Ventron/Velsicol OU-1 Site has been assigned the site identification code ‘VV’.;
- A Unique Sample Code (see below);
- Location Sampled Code (use same code as used in EQuIS database, e.g., MW-1);
- Date Sampled (format as day-month-year, i.e., dd mm yyyy e.g., 12 Feb 2003). This is an internationally recognized format and avoids confusion;
- Time Sampled (HH:MM in military format. Include leading zeroes and colon, e.g., 09:30, 13:45);
- Depth at which sample was taken, including units (in feet);
- Sample matrix code;
- Analyses to be performed on the sample;
- Initials of sampler;

- “Filtered” or “Unfiltered” (this classifies the sample as “dissolved” or “total”); and
- Description of any preservation done.

Additionally, sample labels may contain the following optional information:

- Sample collection method (grab vs. composite);
- Container number (e.g., 1 of 2; 3 of 5); and
- Comments—any other information.

The Code assigned to a Sample at the time it is collected is a critically important part of the data management system and therefore should conform to the following specification. The code must be unique and contain the following six (6) items.

[date location depth preservation filtration type]

Example: A NORMAL environmental sample from well MW-21 from a depth of 25 feet on 3 Jan 2007.

20070103MW-21V25N

The date: use the format “YYYYMMDD” (“YYYY”=four-digit year, “MM”=two-digit month, and “DD”=two-digit day) Ex. 20070103 for 3 January 2007

This form of the date is used so that samples will sort chronologically.

The location: use the location code that has been assigned to the location where the sample was taken, e.g., MW-21 (see restrictions below)

The depth at which the sample was taken:

- for wells, use the depth in the well where the pump inlet was located prefixed with a “V” for Vertical (e.g., V25);
- for soil samples use the “V” prefix followed by the sampled range (e.g., V2-4); and
- for samples from wells where the vertical depth of the sample is not known, use the "V" prefix followed by the depth of the midpoint of the screened interval followed by the character “@”, e.g., V34@. The @ symbol indicates that the depth was derived and is not a measured value.

The use of preservation:

- for samples that would normally be preserved, such as VOA samples and metals samples, but where it is desired to collect an unpreserved sample, indicate that the sample is unpreserved by including the character “U” in the sample code immediately after the depth entry; and

- for samples that would normally be unpreserved, such as SVOC samples, but where it is desired to collect a preserved sample, indicate that the sample is preserved by including the character "P" in the sample code immediately after the depth entry.

The use of filtration: if the sample is filtered, place a “D” in the code immediately in front of the sample type to indicate that the sample contains only Dissolved components.

The sample type: e.g., “N” for a normal environmental sample

Restrictions:

Currently the sample code is limited to 40 characters by a field length limitation in the EQuIS database. If you construct a sample code and it exceeds the 40 character limit, contact Corporate Remediation Group to determine how to contract the sample code while assuring that the code remains unique. Refrain from using spaces in the code and use dashes only in the location code and depth range.

Experience has shown that certain characters cause a problem with lab Laboratory Information Management System (LIWS) data systems and therefore should not be used in the location codes or the sample codes (see the list below).

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<tr><td>ampersand</td><td>&</td><td>back quote</td><td>`</td></tr>
<tr><td>backslash</td><td>\</td><td>dollar sign</td><td>$</td></tr>
<tr><td>double quotes</td><td>"</td><td>pipe or vertical bar</td><td>|</td></tr>
<tr><td>semi colon</td><td>;</td><td>single quotes</td><td>'</td></tr>
<tr><td>colon</td><td>:</td><td>any parenthesis or brackets</td><td>{ }, ( ), [ ]</td></tr>
<tr><td>forward slash</td><td>/</td><td>asterisk</td><td>*</td></tr>
<tr><td>greater than</td><td>></td><td>lest than</td><td><</td></tr>
<tr><td>question mark</td><td>?</td><td>curly quotes</td><td>“ ”</td></tr>
</table>

Field Quality Control Samples

Field Duplicates

A field duplicate is given the same code as the normal sample except that the designation “FD” is used instead of “N”. Ex. 20020103MW-21V25FD

Field Blanks

Field Blanks are labeled with the date, site code, and the designation “FB”. Ex. 20020103VVFB.

When there is more than one field blank for a given day, a unique sequence number should be added. Ex. 20020103VVFB-1.

Equipment Blanks

Equipment Blanks are labeled with the date, the site code, and the suffix "EB". Ex. 20020103VVEB

If there were more than one Equipment Blank for a given day, a unique sequence number should be added. Ex. 20020103VVEB-1

Rinse Water

Rinse Water samples are labeled with the date, the site code, and the suffix "RW". Ex. 20020103VVRW

Well Construction Materials

Samples of materials used in the boring and installation of a well are labeled with the date, the site code, and the suffix "MB". These materials include drilling muds, drilling water, grout, cement, sand, etc. Ex. 20020103VVMB

4.4.3 Lab Samples

The laboratory is responsible for maintaining and documenting sample custody from sample receipt until final analysis, reporting, and disposal. The chain-of-custody procedures for each analytical laboratory are detailed in the laboratory-specific quality assurance plans. These COC procedures are comparable to those required in the CLP RAS and meet all NJDEP certification requirements. It is the responsibility of the STL QA Manager to ensure that sample integrity and documentation are maintained sufficiently through the established custody procedures. These procedures are subject to audit (laboratory internal or external audits). The custody procedures are summarized below.

Sample Receipt

Upon receipt in the laboratory, the Sample Custodian, or representative, will unpack the shipping containers, compare the contents with the COC record, and sign and date the record. The Sample Custodian will also record the carrier and air bill number on the original COC form, if it is not already present. A Sample Receiving Checklist will be completed by the Sample Custodian or designee for each shipment received at the laboratory. Upon sample receipt, the Sample Custodian or designee will:

- Inspect the sample shipment containers for the presence of intact custody seals. If custody seals are missing, the Parsons Project Manager must be immediately notified to confirm if custody seals were inadvertently left off. If there is any indication of invalid custody seals (either broken seals upon receipt or missing custody seals with an indication that custody seals were placed prior to shipment), the entire sample shipment may be excluded from analysis at the discretion of Morton International, Inc. and the Parsons Project Manager;

- Open the sample shipment containers in a secure limited access area;

- Determine if proper temperature has been maintained during shipment. The receiving temperature will be recorded on the COC form. Any receipt outside 4°C (plus or minus 2°C) that will impact the usability of the data should be immediately reported by telephone to the Parsons Project Manager;

- Inspect the samples for breakage or other damage. If samples have been damaged during shipment, the remaining samples will be carefully examined to determine whether they were affected. Any samples suspected of being affected will also be considered damaged. It will be noted on the COC record what specific samples were damaged and that the samples were removed from the sampling program. The Parsons Project Manager will be notified as soon as possible by telephone and in writing that samples were damaged and that they must be re-sampled, or the testing program changed. The cause of damage must also be determined;

- Compare samples received against those listed on the COC and the Laboratory Work Request. Discrepancies must be immediately reported by telephone to the Parsons Project Manager;

- Verify that sample holding times have not been exceeded. If the sample holding time has been exceeded, the Parsons Project Manager must be notified by telephone as soon as possible. In addition, written notification must be sent to the Parsons Project Manager that this has occurred;

- Sign and date the COC form and attach the air bill to the COC form;

- Verify pH of samples that are preserved according to the COC. This step may be performed during sample login or during extraction/analysis. Discrepancies in the actual preservation and the listed preservation must be reported immediately to the Parsons Project Manager;

- Place the samples in adequate laboratory storage;

- Log the samples into a computerized LIMS that should contain, at a minimum, the following information:

    - Project identification number;
    - Sample numbers;
    - Type of samples and tests requested;
    - Date received in laboratory; and
    - Sampling date.

- Notify the laboratory manager or group leaders of sample arrival. If extremely short holding time (24 hours from receipt or less) analyses are required, another parallel mechanism for expedited notification of the appropriate departments should also be used; and

- Place the completed COC records in the laboratory project file and forward a signed copy of the COC to the Parsons Project Manager.

If samples collected arrive without COC or incorrect COC records, the actions described below will be taken by the Sample Custodian.

If the COC form is incorrect, a telephone call will be made as soon as possible, and a memorandum to the Parsons Project Manager will be prepared outlining the deviations from accepted procedure. The memorandum must be signed and dated by the person originating the COC and the Sample Custodian. The memorandum will serve as an amendment to the COC. If the information on the COC form cannot be corrected by the Sample Custodian or the field personnel, the samples affected will be removed from the sampling program.

If the COC form was generated but not shipped with samples, the field personnel will immediately contact the laboratory Sample Custodian and a memorandum will prepared by the Parsons Project Manager that lists the persons involved in collecting, shipping, and receiving the samples and the times, dates, and events. Each person involved must sign and date this memorandum. The COC form will be immediately forwarded (via facsimile) to the laboratory and the memorandum attached to it and placed in the file.

If a sample set arrives at the laboratory without a COC form and it is determined that a COC form was not prepared for the respective sample set, an attempt will be made to reconstruct the COC form based on field information and this COC will be accompanied by a memorandum from the Parsons Project Manager. If it is determined that a COC can not be reconstructed, then the affected samples will be removed from the sampling program and a subsequent set of samples will be collected and submitted to the laboratory along with a COC form.

Sample Analysis and Disposal

The Laboratory Project Manager will inspect the paperwork and, if all is in order, will direct the laboratory sections to initiate extraction and analysis. If problems are noted, the Laboratory Project Manager will resolve them with the Parsons Project Manager.

After log-in, samples will be placed in limited-access, refrigerated (at 4°C) storage, pending preparation and analysis. Sample COC must be maintained throughout the laboratory by a system of door locks. All external doors to the laboratories will be kept locked at all times. Access will require use of a key issued to company employees. Thus, in order to gain access to the laboratories, one must either be an employee or be escorted by an employee.

For this project, all field samples and extracts are to be retained by the laboratory for three months from date of delivery of hard-copy results.

Laboratory personnel will comply with all internal laboratory COC procedures as defined by the specific laboratory's procedures.

4.4.4 Sample Labeling - Lab Generated Samples

Each lab has its own system for identifying samples as they come into the lab from the field. This designation for each sample analyzed is placed on the SMP Electronic Data Deliverable (EDD) along with the date the sample arrived in the lab. The lab also adds to the SMP EDD the Lab Project Number and the Morton International, Inc. Purchase Order Number under which the analyses are being performed.

The following naming conventions will be used to generate unique sample codes to identify Lab Quality Control Samples. These designations will be used in each of the EQuIS Imports, CRG SMP, CRG TRSQC, and CRG BAT, to describe and track the measured analytical results associated with these samples.

Trip Blanks

Trip Blanks are labeled with the date, site code, and the designation “TB”. Ex. 20020103VVTB

When there is more than one trip blank for a given day, a unique sequence number should be added. Ex. 20020103VVTB-1

Blind Samples

In some cases a sample, for QA/QC purposes, will have to be submitted to the lab with a "blind" sample code. The blind code must be unique and the field staff must make an entry in their field logbook cross-referencing this blind code with the correct CRG sample code for that sample. When the results return from the lab, the cross-reference will allow them to enter the results into the database under the correct CRG sample code rather than the blind code.

Matrix Spikes

A matrix spike sample is given the same code as the normal sample which is its parent except that the designation “MS” is used instead of “N”. Ex. 20020103MW-21V25MS

Matrix Spike Duplicates

A matrix spike duplicate is given the same code as the normal sample which is its parent except that the designation “SD” is used instead of “N”. Ex. 20020103MW-21V25SD
Note: When matrix spike and matrix spike duplicate samples are both to be taken, separate containers must be prepared by the lab for each of these samples. Past practice of using a single container to hold the material for both these samples has been discontinued and the sample type designation “MSD” eliminated.

Lab Replicates

When the lab runs a replicate analysis on a sample, a new sample code is assigned to the sample which consists of the original sample code with the added ending “LR”. Ex. Parent Sample Code 20020103MW-21V25N. Ex. Lab Replicate Code 20020103MW-21V25NLR

Method Blanks

The sample code is constructed using the convention of the lab doing the analysis followed by “MB”. Ex. Normal Lab Code 04-12-03-564. Ex. Sample Code 04-12-03-564MB

Blank Spikes

The sample code is constructed using the convention of the lab doing the analysis followed by “BS”. Ex. Normal Lab Code 04-12-03-564. Sample Code 04-12-03-564BS.

Blank Spike Duplicates

The sample code is constructed using the convention of the lab doing the analysis followed by “BSD”. Ex. Normal Lab Code 04-12-03-564. Ex. Sample Code 04-12-03-564BSD

Lab Control Samples

The sample code is constructed using the convention of the lab doing the analysis followed by “LCS”. Ex. Normal Lab Code 04-12-03-564. Ex. Sample Code 04-12-03-564LCS

Surrogates

Surrogates are reported along with the results for a sample and therefore fall under the sample code of that sample. The Surrogate result type is designated as “SUR” and the surrogate recoveries are reported in the QC results section, not in the sample analytical results section.

Internal Standards

Internal Standards are reported along with the results for a sample and therefore fall under the sample code of that sample. The Internal Standard result type is designated as “IC” and the measured values are compared to the Standard in the QC results section, not in the sample analytical results section.

4.4.5 Chain of Custody (COC) Form

COCs will be used as a primary documentation mechanism to provide for proper documentation of all information pertaining to each sample. COC forms are utilized to record the sampling location, type and amount of sample collected, preservatives, requested analyses, date/time of sample collection, sampler name, date/time of custody transfers, custody transfer signatures, and other pertinent information for each sample. A copy of the COC to be used for this project is included in Appendix A-3 for reference, although comparable COCs may be used at other times throughout the program as long as all required information is recorded.

A COC form will be initiated in the field and will accompany each group of samples during shipment to the laboratory. COC forms should not be prepared by individual cooler. However, a copy of the COCs or an identification of a contact should be provided with each cooler in case the cooler containing the original COCs is lost in shipment. Each time the custody of a sample changes, the new custodian will sign the form and record the date/time of taking possession. Following completion of COC forms, original COC forms are provided to the laboratory by placing COC forms in a self-sealing, Ziploc®-style bag and shipping with a sealed sample shipment container under custody.

Each page of the COC form should contain a unique Identifier for that Form clearly indicated on the Form. The following identifier format is recommended:

YYYYMMDDCOC-X

where X is a sequential number used only once on any given day (e.g., 1, 2, 3, etc.) "YYYY"=four-digit year, "MM"=two-digit month, and "DD"=two-digit day

"YYYYMMDD" represents the date on which the samples were packaged and shipped or relinquished to the lab. The sequential number is used to indicate the number of forms (pages) prepared on a single day. Example: for two Containers going to the Lab on 3 February 2002:

20020203COC-1
20020203COC-2

4.4.6 Sample Shipment

Custody documentation is critical during sample shipment both to prevent sample tampering and to minimize the opportunity for sample holding times to be compromised.

The critical documentation to prevent sample tampering is signed custody seals. If appropriate, each sample shipment container (cooler) will be secured through the use of signed and pre-numbered laboratory custody seals affixed to each cooler. Custody seals must never be pre-signed but rather must be signed at the time of securing the cooler. Custody seals must be secured with clear tape to prevent detachment and subsequent reattachment of the seals. In addition, 2-inch-wide clear tape will be wrapped entirely around the cooler.

To further document and assist sample tracking, the sender's copy of the air bill must be maintained on file. For samples shipped by commercial carrier, the air bill serves as an extension of the COC record between the final field custodian and receipt in the laboratory. To correlate against the air bill, the method of shipment, courier name, air bill number, and other pertinent shipment information will be entered on the COC form.

All water and soil samples will be placed in laboratory supplied coolers and iced to 4^{o}C (+2^{o}C) after collection and labeling. Air sampling canisters will be placed in the original shipping cartons. All samples will be delivered to the laboratory within 48 hours of sample collection by commercial courier.

Individual sample bottles will not be sealed; however, each cooler will be sealed with a transportation security seal containing the sampler's initials. The cooler will then be sealed with packing tape.

Each Container that carries samples to the analytical laboratory should have a unique container code and that code should appear on the Chain of Custody. Any convention is acceptable so long as the Identifier is unique. The following format is suggested:

YYYYMMDDLabBOX-Z

Where Z is a sequential number used only once on any given day (e.g., 1, 2, 3, etc.) “YYYY”=four-digit year, “MM”=two-digit month, and “DD”=two-digit day, and "Lab" is the Lab Code for the Lab doing the analyses.

“YYYYMMDD” represents the date on which the container was packaged and shipped to the lab. The sequential number is used to indicate the number of the cooler prepared on the same day. Example: for two Containers going to the STL Lab in Edison on 3 February 2002:

20020203STL-EDBOX-1
20020203STL-EDBOX-2

4.5 Field Equipment

4.5.1 Field Decontamination

Prior to mobilization, the drilling rig and all associated excavation equipment will be thoroughly cleaned to remove oil, grease, mud and other foreign matter. In addition, before initiating drilling or excavating at each location, the augers, cutting bits, samplers, drill steel and associated equipment will be thoroughly cleaned at the Decontamination Area to prevent potential cross-contamination from the previous drilling location. The equipment will be inspected by the Contractor's on-Site personnel after cleaning and prior to initiation of drilling. Cleaning will be accomplished by flushing and wiping the components to remove all visible sediments followed by a thorough high-pressure steam wash and rinsing. Special attention will be given to the threaded sections of the drill rods and split spoon samplers.

All equipment used for the collection of samples for chemical analysis which require pre-cleaning including tubing, pumps, spoons, trowels, grab samplers, and split-spoons will be cleaned between each sampling location/interval according to the following protocols;

1) wash with detergent (Alconox);
2) rinse with potable water;
3) rinse with distilled and deionized water;
4) rinse with rinse with 0.1N nitric acid (use for metals analyses only);
5) rinse with generous amounts of distilled and deionized water;
6) rinse with acetone;
7) allow to air dry; and
8) rinse with distilled and deionized water.

The distilled and deionized water which is used for cleaning sampling tools will be sampled once for TCL VOCs, TCL SVOCs, and TAL metals analyses.

The bottom three feet of the water level measuring equipment will be cleaned prior to use in each well with an acetone- and deionized water rinse.

A Decontamination Area will be constructed with a polyethylene liner. The Decontamination Area will be equipped with a stainless steel or aluminum foil wrapped rack for staging equipment to be decontaminated. Following decontamination, the equipment will be transferred to an adjacent aluminum foil wrapped table for immediate use or for storage.

Equipment will be protected from all forms of chemical contact between final rinse and initial use. Equipment (bailers, split-spoon, etc.) that will not be used immediately following cleaning in the Decontamination Area, will be wrapped in foil and placed on a 6-mil polyethylene sheeting until the equipment is needed.

4.5.2 Field Calibration

All instrumentation used to perform chemical measurements must be properly calibrated prior to use in order to obtain valid, documentable, and acceptable results. This section describes procedures for maintaining the accuracy of all the instruments and measuring equipment that are used for conducting field tests and laboratory analyses. These instruments and equipment should be calibrated prior to each use or on a scheduled, periodic basis. The procedures described herein are to be used in conjunction with the specific laboratory/field procedures for instrument operation, any relevant analytical methodology requirements, and instrument manufacturer's instructions.

The field personnel, under the direction of the Parsons Field Team Leader, are responsible for the proper calibration of field equipment in compliance with this QAPP, field procedures for instrument operation, and instrument manufacturers' instructions. The Parsons QA Officer is responsible for auditing calibration methods and documentation to ensure consistency with this QAPP, field procedures for instrument operation, and instrument manufacturers' requirements.

Calibration of field instruments is governed by the specific operating procedure for the applicable field analysis method, and the requirements of the NJDEP FSPM (August 2005). Such procedures take precedence over the following general discussion.

The field measurements defined for this project may require the following instrumentation: explosive atmosphere/oxygen meters, gas-specific meters (e.g., sulfur, methane), electronic balances, flame or photoionization detectors, and XRF analyzer. All field equipment will be calibrated using verified standards (traceable to appropriate NIST standards where possible), at least daily or at the frequencies recommended by the manufacturer, whichever is greater. Balances will be calibrated with class C weights and inspected by a certified technician at least annually or at the start of the field program. Daily checks will confirm balance calibration. All instruments will be maintained and repaired in accordance with the manufacturers' specifications. In addition, prior to use, each major piece of equipment will be cleaned, decontaminated, checked for damages, and repaired, as needed. Calibration procedures, including date of calibration, readings, type, concentration of standards and source of calibration standards, will be recorded in the field log or individual instrument calibration log, if available.

Despite even the most rigorous maintenance program, equipment failure can occur. When equipment cannot be repaired in the field, it will be replaced as quickly as possible. Field notes from previous sampling trips will be reviewed to ensure that prior equipment problems are addressed. Wherever possible, spare instrumentation and parts, such as a spare pH electrode or photoionization lamps, will be maintained onsite or will be readily available. Problems identified with specific equipment will be reported immediately to the field team leader to assess the problem and mange for repair or replacement.

The EPA analytical methods selected for use in this investigation specify the types and frequency of calibrations.

For accessory analytical equipment such as balances and ovens that are required in preparation procedures, calibrations will be performed per manufacturers' instructions and the following guidelines:

- Calibrations of balances and ovens must be checked daily and recorded in a log-book or appropriate calibration-specific log;
- Corrective actions must be taken for out-of-control check measurements as described in the laboratory's quality assurance plan or manual;
- The equipment will not be used until either it is recalibrated or corrective action results in a subsequent check standard meeting control criteria; and
- Calibration of other miscellaneous analytical equipment (e.g., automatic pipettes) will be performed according to manufacturers' recommendations.

Implementation of the laboratory calibration program will be the responsibility of the Laboratory Director and the analysts. The STL QA Manager has the responsibility to review and oversee the implementation of the laboratory program during analysis of project samples.

4.5.3 Field Preventative Maintenance

Maintaining equipment in good working order is critical to the generation of quality data both in the field and in the laboratory. Parsons utilizes a preventative maintenance program to minimize costly field equipment downtime, scheduling problems, or generation of suspect data. All field equipment and supplies are routinely maintained, stocked, and cared for by personnel who are specifically responsible for field equipment and supplies. The Parsons Field Team Leader manages the system of obtaining and maintaining working field equipment used in the collection of samples or measurement of data. The Health and Safety Officer is responsible for ensuring health and safety equipment is working properly. An inventory of equipment, including model and serial number, quantity, and condition will be maintained. Each item will be tagged and signed out when in use, and its operating condition and cleanliness will be checked upon return. Routine checks will be made on the status of equipment, and spare parts will be stocked. An equipment manual library will also be maintained. Field equipment will be properly cleaned according to decontamination and instrument specifications after each use and malfunctions will be reported to the responsible personnel.

Field sampling personnel will be familiar with the field calibration, operation, and maintenance of the equipment, and will perform the prescribed field operating procedures outlined in the manufacturers' instructions. All equipment will be inspected at least twice, once before start-up and again at the end of the work shift. All preventative maintenance performed will be entered in individual equipment maintenance logs.

4.5.4 Laboratory Preventative Maintenance

The laboratory also follows a well-defined program to prevent the failure of laboratory equipment and instrumentation. The preventive maintenance program will be as specified in the analytical methods and/or laboratory SOPs, whichever are more stringent. This program includes specific procedures as illustrated in the following examples:

- Laboratory staff will be trained in the maintenance requirements of the instrumentation used in this program. Preventative maintenance schedules and procedures will be outlined in the laboratory's SOPs and will be adhered to; and
- An inventory of replacement and spare parts for instrumentation will be maintained. Maintenance log books for each instrument will be kept along with information on routine and non-routine maintenance procedures. Records of maintenance activities will include identification of the instrument with identification number, date of activity, and the maintenance activity performed.

4.5.5 Inspection of Consumables

Prior to commencing sample collection activities each day, the Parsons field team leader will inspect all consumable items (gloves, collection bags, tubing, etc.) for defects or signs of excessive wear that may impact sample quality. All items of questionable quality will be immediately discarded and replaced.

All safety equipment will undergo routine inspection by the Parsons Health and Safety Officer as described in the Health and Safety Plan.

4.6 Field Activities Documentation

A field logbook for all sampling activities will be maintained for later data validation and reporting. The field logbook will be used in accordance with the NJDEP Field Sampling Procedures Manual (August 2005), and include information related to sampling activities (date, location, equipment, etc.), as well as all available information related to quality control and assurance. The information maintained in the field logbook will be used to generate a field report submitted to Morton International, Inc. and Parsons Project Managers.

4.7 Quality Control

Internal QC procedures include both field and laboratory check samples and procedures designed to ensure and document the overall quality of the data. QC check samples are control samples introduced into the analytical system at specific points. The results of the QC checks are used during data assessment to evaluate precision, accuracy, representativeness, completeness, and comparability of the overall sampling and analytical program. The type and frequency of QC check samples required for this project are summarized in **Table 4-3**.

4.7.1 Field Quality Control Checks

To verify the performance of field sampling activities, QC samples are collected for analysis. Field QC checks consist of control samples that are introduced to the laboratory from the field. The sampling team will use several types of QA/QC samples to ensure and document the integrity of the sampling procedures, sample-handling procedures, and the validity of the measurement data. Primarily these field-generated QC samples will be: field rinsate blanks, trip blanks, field duplicates, and temperature blanks. Frequency of collection is summarized in **Table 4-3**. Bottles and blank water will leave the laboratory and arrive back at the laboratory within seven days.

Additional QC and blank samples will be introduced on an as-needed basis to address specific project needs. For example, additional blanks may be warranted in cases where contamination is indicated and the currently planned samples do not provide sufficient information to allow identification of the source and institution of corrective actions. Additional field-generated QC samples that may be utilized on an as-needed basis include:

- Storage blanks - blanks that accompany bottle storage, particularly bottles maintained under onsite conditions;
- Bottle blanks - to ensure that the bottles provided are sufficiently cleaned and are not contaminated;
- Field blanks - water opened and poured under field conditions without rinsing equipment to differentiate between contamination due to ambient site conditions versus inadequate equipment decontamination;
- PE samples- samples of known and well-defined concentration provided to the laboratory as

independent assurance of laboratory performance; and

- Blind spikes - samples spiked in the field with known concentrations and provided to the laboratory along with routine samples.

All field blank water and trip blanks will be shipped with the sample containers and arrive onsite within one day of preparation. Blanks and the associated samples will be held onsite for no longer than two calendar days and will arrive at the laboratory within one day of shipment from the field. All blanks and samples will be maintained at 4°C while stored onsite and during shipment. Sample bottles and blanks will be handled in the same manner prior to their return to the laboratory.

Field Rinsate Blanks

Equipment rinsate blanks will be prepared to determine if cross-contamination has occurred during sampling. Two sets of identical bottles, one set containing analyte-free water and one empty set, will be provided by the laboratory. The analyte-free water from the set of bottles is poured over or through one set of field sampling devices utilized to collect samples following decontamination of the equipment. This water is then collected into the empty set of bottles. Rinsate blanks will be preserved in the same manner as aqueous samples. For nonaqueous samples, rinsate blanks will be prepared at a frequency of one per 10 of the total number of samples collected or one per day, whichever is less frequent. Rinsate blanks for aqueous samples will be collected at a rate of one per day. However, since rinsate blanks require rinsing of the equipment, sample collection methods that do not utilize sampling equipment cannot, by definition, have a rinsate blank. In these cases field blanks will be collected at the same frequency as rinsate blanks. The rinsate blank will be analyzed for the same parameters as the associated samples. This will include collecting filtered rinsate blanks when water samples are being collected for dissolved metals. This blank will consist of laboratory deionized water passed through the filter apparatus in the field. The filtered rinsate blanks will be collected and analyzed at the same frequency as the rinsate blanks, but only for association with the field-filtered (dissolved) metals samples.

Trip Blanks

To determine if cross-contamination of samples has occurred during shipping, one trip blank will be provided by the laboratory for each shipment of aqueous samples for volatile analysis. Trip blanks are not required for nonaqueous samples. Trip blank samples are prepared by the laboratory and consist of at least two 40-ml vials filled with analyte-free water. Trip blanks will be returned to the laboratory unopened with the same set of bottles they were shipped with and will not be held onsite for more than two calendar days. All trip blanks will be analyzed for volatile organic parameters (including volatile alcohols) only.

Field Duplicates

Field duplicate samples will be collected to evaluate the reproducibility of the sampling technique. Field duplicate samples will be collected for each matrix at a rate of 1 for every 20 samples per matrix. If less than 20 samples are collected during a particular sampling event, 1 field duplicate will be collected.

Temperature Blanks

Temperature blanks will be shipped with samples (one for each cooler) for confirmation of shipping conditions/temperature.

4.7.2 Laboratory Quality Control Checks

Laboratory QC checks include the analysis of blanks, spiked samples (laboratory control samples, matrix spikes, and matrix spike duplicate samples), duplicate samples (inorganics only), surrogates (organics only), and initial and continuing calibration checks. The laboratory will maintain a QC program that will contain, at a minimum, those QC checks listed in **Table 4-5** and described briefly below. Criteria that laboratory blank and spiked sample analyses must meet are also summarized in **Table 4-5**. Laboratory QC samples will be checked against analytical method and data usability requirements during the usability review process.

Method Blanks

Method or preparation blanks are generated within the laboratory during the processing of the field samples. These blanks are processed using the same reagents and procedures and at the same time as the samples being analyzed. Contamination found in method blanks indicate that similar concentrations found in associated samples may be attributable to the same source of contamination and not actually present in the field samples. Method blanks will be analyzed at a minimum frequency of 1 per 20 samples per matrix or per preparation/analysis batch. Criteria for acceptance of method blanks are method-specific.

Analytical blanks (initial and continuing calibration blanks) are required by inorganic EPA methods and as QC defined in the QAPP. Blanks consist of laboratory reagent-grade water and acid solutions to match sample digestates analyzed at the beginning, intervals during, and at the end of an analytical sequence to assess contamination and instrument drift. The initial calibration blank (ICB) is analyzed at the beginning of the analytical run following the calibration and initial calibration verification (ICV). The continuing calibration blank (CCB) is analyzed prior to sample analyses, every 10 samples thereafter, throughout the analytical run, and at the end of the analytical sequence.

Matrix Spikes and Matrix Spike Duplicates

Matrix spike (MS) samples are prepared by placing a known quantity of target analytes into a field sample. The MS is then processed in a manner identical to other samples. Percent recovery of each target analyte reflects the ability of the laboratory and method to accurately determine the quantity of that analyte in that particular sample. Note that it does not necessarily reflect the ability to determine that analyte or other chemically similar analytes in other, even similar samples. If a quantity of the spiked analyte exists in the sample prior to addition of the spike, this quantity is subtracted from the matrix spike results to determine the quantity of the spike that has been recovered.

Matrix spike duplicate (MSD) samples are prepared for all organic analyses as QC checks on the precision. MSDs are prepared and handled identically as matrix spikes. The relative percent difference (RPD) is a measure of the comparability of the MS and MSD results and thereby provides a measure of analytical precision. For all organic analyses, an MS/MSD pair will be prepared and analyzed at the frequency of 1 per 20 samples per matrix or per preparation/analytical batch.

Laboratory Duplicates

For inorganic analyses, a laboratory duplicate (LD) is prepared and analyzed to provide a measure of precision by comparing the RPD of all positive results in the sample and LD. A sample/LD pair will be analyzed at a frequency of 1 per 20 samples per matrix or per preparation/analytical batch. RPD criteria for LD samples are analyte and method specific and are summarized in **Table 4-5**.

Surrogate Spikes

Analytical samples to be analyzed for organic analyses will have surrogate compounds added before analysis or extraction. The recovery of these surrogate compounds aids the analyst in determining matrix effects on recovery of compounds in each sample.

Laboratory Control Samples

Laboratory Control Samples (LCSs) are samples prepared by adding known amounts of analytes to a blank matrix. LCS samples are analyzed concurrently with project samples. The recovery of analytes in LCSs measures the ability of the method and laboratory to accurately quantify target analytes without the presence of matrix effects or interferences.
An LCS is prepared and analyzed at the frequency of 1 per 20 samples per matrix or per preparation/analytical batch.

Calibration Criteria

Calibration checks will be performed according to the method-specific requirements but are summarized below. Calibration criteria specifics are detailed in the individual analytical methodologies.

Organic Analyses:

- Multilevel (typically five-point) initial calibrations of instruments to establish calibration curves;
- Continuing calibration standards at least once every 12 hours of gas chromatography / mass spectrometry (GC/MS) instrumental analyses and once every 20 samples of 12 hours of GC instrumental analysis; continuous calibration standards at the end of analysis to ensure continued, accurate quantitation; and
- Instrument tuning of GC/MS systems every 12 hours using bromofluorobenzene for volatile analyses and decafluorotriphenylphosphine for semi volatile analyses.

Inorganic Analyses:

- Calibration curves generated by analyses of individual or mixed standards;
- Initial calibration verification at the beginning of each run and continuing calibration verification at a minimum frequency of 1 every 10 samples to verify calibration; and
- Inductively coupled plasma interference check standards after initial calibration to verify inter-element and background corrections.

Performance and system audits of both field and laboratory activities will be performed on a periodic basis, as appropriate, to ensure that the sampling and analysis are performed in accordance with procedures outlined in the NJDEP *Field Sampling Procedures Manual* (August 2005) and this remedial action QAPP.

4.8 Performance Audits

4.8.1 Internal Performance and System Audits

Members of the project team may perform documented internal audits of project activities prior to or during the course of the analytical program as part of a proactive approach to ensure that the project's DQOs are met, as necessary. Follow-up audits to assess corrective actions to specific findings may be performed. Audits will consist, as appropriate, of an evaluation of QA procedures and the effectiveness of their implementation, an evaluation of work areas and activities, and a review of project documentation. Audits will be performed in accordance with written checklists. Audit results and any follow-up response from the audited activity will be formally documented and maintained in the respective project files. The parties responsible for performing the audits are specified in Section 4.10.

4.8.2 External Performance and System Audits

Laboratory and field activity audits may be performed prior to or during the course of the analytical program as part of a proactive approach to ensure that the project's DQOs are met, as necessary. If performed, the audits will be conducted by the parties identified in Section 4.10. Each laboratory has previously undergone, or will undergo, prior to analysis of samples, a comprehensive onsite audit.

External audits of laboratory or field activities during the project may be performed at a frequency to satisfy the project team that the sampling and analysis is progressing within the QA/QC limits set forth in this section and the referenced EPA methods.

Specific elements of the field oversight/audit will include verification of the following items:

- completeness and accuracy of sample chain-of-custody forms, sample identification labels, and field log books;
- compliance with the specific decontamination procedures as delineated in the Workplan;
- compliance with the specific collection, preparation, preservation, and storage procedures

outlined in this section (i.e., QAPP);
- compliance with the specific calibration and analytical procedures for field measurements as outlined in this section (i.e., QAPP); and
- compliance with the handling and shipping procedures outlined in this section.

Onsite laboratory audits may be performed during the program for one or more of the following reasons:

- Significant changes are made to the information in this section (i.e., QAPP);
- The DAR or other review documentation indicates a problem;
- To verify that corrective action has been taken on a nonconformance or QA/QC problem in the laboratory; and
- An audit is specifically requested by the senior representatives of the project team.

The following represent some of the significant items that should be included in the checklist for a full-scale audit of a laboratory by external auditors:

- Sample flow through laboratory and internal sample tracking;
- Chain-of-custody procedures;
- Sample storage;
- Sample preparation/extraction and analysis information;
- SOPS;
- Log books or benchsheets for all preparation procedures of samples, calibration standards. QC standard/check samples, blanks;
- Log books or bench sheets for all analytical procedures of samples, calibration standards, QC standard/check samples, blanks;

- QC sample documentation inclusive of items above and for all blanks, calibrations, calibration verification check samples, LCS, spikes, duplicates, spike duplicates, surrogates, control charts (where applicable);
- Hard copy of all data, other media (disk, tape, etc.); and
- Laboratory QA procedures including internal audits, corrective action forms. and QC control charts.

After completion of an external audit, the auditor(s) will prepare and submit an audit report for distribution to the project team. The report will be prepared as soon as possible after the audit and contain the following, as appropriate:

- Date(s) of the audit;
- Identification of audit participants;
- Audit results;
- Description of items requiring corrective action and, if possible, the means of correction; and
- Due date for completion of corrective actions and/or audit response.

The individuals audited will respond in writing to the audit report. The response will clearly state the corrective action(s) taken or planned. If all corrective actions have not been completed prior to issuance of the audit response, a scheduled date for completion will be mandated. All requests for corrective action must be addressed to the satisfaction of the respective QA Officer.

Completion of corrective action will be verified by the auditor(s) through written communication, re-audit, or other appropriate means. After acceptance and verification of corrective actions, an audit closure report will be issued by the audit team leader.

4.9 Data Management / Reporting

All data collected during the Ventron/Velsicol OU-1 remedial action activities, including field and laboratory activities, will be recorded, reduced, reviewed, and reported. Parsons is responsible for these functions for field sample collection and for all field-generated analytical data. Each offsite contract laboratory receiving field samples is responsible for the recording, reduction, reviewing, and reporting of the corresponding analytical results. Designated aspects of the data review and assessment requirements are assigned to members of the remedial action team.

Raw data consists of instrument responses in the form of meter, recorder, or printer output. The technician/operator performing the analysis either will enter the field or bench-generated data in a field or laboratory workbook/worksheet specific for each parameter or will reduce the data via specific computerized software programs. These data must include: instrumental responses (absorbances, concentrations, etc.), standard and spike concentrations, sample identification numbers, and all other pertinent information. All reductions of data, whether manual or computerized, must follow the procedures and equations provided in the respective testing protocols. The reduction of field data will consist of summarizing the raw field data, which may be presented in the form of tables, logs, illustrations, and graphs, as deemed appropriate by the task manager.

For laboratory analyses in which the raw data consist of instrument responses in the form of computer-generated data files, data output should be stored by the laboratory in project specific files. The computer-generated data files must be archived electronically for possible retrieval at a later date.

The field measurement data will be reduced into a tabulated format suitable for inclusion in the remedial action report and will be designed to facilitate comparison and evaluation of the data. These tabulations will include, but not be limited to, the following information:

- Field screen results;
- Field analyses; and
- Water-level measurements and surveyed measuring point elevations.

Field logs will be transferred into typed formats or organized in their original form for inclusion in the remedial action report as appendices. The following log forms will be used:

- Sample/core logs;
- Test pit logs; and
- Water level logs.

The tables and logs will be compiled, whenever feasible, by the field team leader, who will inform the task manager of any problems encountered during data collection, identify apparent inconsistencies, and provide opinions on the data quality and limitations.

4.9.1 Quality Assurance Data Review

A quality assurance review of data for all chemical analyses of samples collected as part of the remedial action will be conducted in a manner consistent with the procedures used for the remedial investigation / feasibility study portion of the project. The quality review will be conducted to verify that all required laboratory quality control procedures were completed and documented and that the quality of the data is sufficiently high to support the intended purpose. Data validation procedures and qualifier assignments will be completed according to the U.S. Environmental Protection Agency (EPA) national functional guidelines for evaluating inorganic and organic analyses (EPA 1994), as applicable.

Data quality is assessed by precision, accuracy, representativeness, comparability, and completeness (PARCC). The applicable requirements and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical methods. Definitions of these parameters and the methods that will be used to evaluate them for this investigation are described in this section.

Representativeness
Representativeness is the degree to which sample data accurately and precisely expresses the characteristics of a population of samples, parameter variations at a sampling point, or an environmental condition. It is a qualitative parameter that is achieved through proper sampling program design using appropriate strategies and techniques. Factors that can affect representativeness include site homogeneity, sample homogeneity at a single point, and available information around which the sampling program is designed. The field sampling program has been designed to maximize representativeness of the selected sampling locations. To assure representativeness in field sampling, several controls will be used during the course of sampling, including the use of field rinsate samples, and the use of trip blanks for volatiles.

Appropriate subsampling procedures shall be employed by the laboratory so that homogenous, representative sample aliquots are analyzed. A sample preparation log shall be maintained to document which subsampling procedures were used for each sample. The method or preparation blank is used to determine whether or not contaminants are present in the laboratory that could have an impact on the sample associated with the method blank. The presence of contaminants gives the possibility for false positive results. Data quality assessment will eliminate the false positive results attributable to blank contamination. False negatives are reduced through the proper use of sample preservatives, containers, and holding times. All liquid samples will be preserved at the time of sampling by the addition of required chemicals, through refrigeration or both. The use of preservation limits biological and chemical degradation that could bias sample results. Soil and water samples will be refrigerated and stored between 2°C and 6°C.

Precision

Precision is a measure of reproducibility of analyses under similar conditions. Precision can be defined as the degree of mutual agreement among individual measurements and represents an estimate of random error. Precision values will be calculated as the relative percent difference (RPD) between laboratory or field duplicate sample results or between the matrix spike (MS) and matrix spike duplicate (MSD) concentrations. The equation is as follows:

$$RPD = \frac{|C1 - C2|}{(C1 + C2)/2} \times 100\%$$

where: C1 = concentration of sample or MS
C2 = concentration of duplicate or MSD

If all analytical specifications are satisfied and sampling error is not suspected, the RPD results may indicate variability in the matrix. RPD results should be used to initiate further evaluation but are not necessarily considered to be indicators of the state of control during analysis or of field conditions. Estimated qualifier flags may be assigned for samples or matrices with high RPDs to indicate sample heterogeneity or high matrix variability rather than a data quality problem. An average RPD may be calculated and reported as a measure of overall analytical precision or matrix variability for methods and analytes with many duplicate samples or analyses.

Accuracy

Accuracy is the degree of agreement between a measured value and the "true" or expected value. As such, it represents an estimate of total error from a single measurement, including both systematic error (or "bias"), and random error that may reflect variability due to imprecision. Accuracy is expressed in terms of percent recoveries determined from results of the MS/MSD sample pair or Laboratory Control Sample (LCS) analyses. Additionally, accuracy will be evaluated for each sample through the percent recoveries of surrogate spikes. Accuracy is also dependent upon method and field blanks, which should be non-detect for all target analytes. For the determination of accuracy, the following equation is used:

$$\text{Percent Recovery} = \frac{\text{measured concentration}}{\text{actual (known) concentration}} \times 100\%$$

Completeness

Completeness can be defined both qualitatively and quantitatively. Qualitative completeness is determined as a function of all factors that contribute to sampling. Quantitative completeness is calculated as the percentage of measurements that are judged to be valid compared to the total number of measurements planned. Effectively, it measures the amount of data available for valid measurements compared to the amount that is lost or destroyed. For this investigation, a completeness factor of 95 percent for all matrices is established, and is strictly defined as the ratio of the number of usable data points (not flagged "R") over the total possible number of data points, by method/matrix.

Comparability

Comparability is a qualitative indicator of the confidence with which one data set can be compared to another. Confidence is achieved by maintaining standard techniques and procedures for collecting and analyzing representative samples and reporting the analytical results in standard units. In addition, comparability between sample data from similar samples is maintained by using standard procedures and standard solutions and materials. Comparability is expressed in qualitative terms by assuring that standard methods are used for all analytical chemistry measurements, samples are collected and analyzed following approved procedures, and sample results are reported in industry standard units appropriate to each method.

4.9.2 Laboratory Data Review

First Level Review

The laboratory analyst generating the analytical data has the prime responsibility for the correctness and completeness of the data. All laboratory data will be generated and reduced following protocols specified in the appropriate EPA SW846 methods or other approved method referenced in this QAPP. The review conducted by the laboratory analyst constitutes the first-level review. At a minimum, the primary analyst will review the data package to ensure that:

- Analysis information is correct and complete;
- Appropriate test method was used;
- Analytical results are correct and complete (including calculations);
- QC samples are within established control limits;
- Blanks are within established control limits;
- All corrections on raw data and any generated forms are appropriately documented; and
- Raw data, calculations, and results are correctly transcribed.

This review is documented by the analyst and included with the data package. In the case of work performed by subcontracted laboratories, the first-level review would be performed by the subcontracted laboratory.

Second Level Review

The laboratory will also conduct a secondary review of the data as an independent and detailed review to ensure that the data set is acceptable for release. The secondary review process will ensure that:

- Chain-of-custody information is correct;
- Holding times were met or exceeded holding times will be documented in the case narrative;
- Sample preparation information is correct and complete;
- Analysis information is correct and complete;
- Appropriate SOPs have been followed;
- Analytical results are correct and complete (including calculations);
- QC samples are within established control limits;
- Blanks are within established control limits;
- Special sample preparation and analytical requirements have been met;

- Documentation is complete;
- Corrections on raw data and any generated forms are appropriately documented; and
- All documents have been initialed and dated in accordance with laboratory SOPs.

The secondary review must be conducted by experienced laboratory personnel who perform data review as a primary function, are organizationally separate from the operating analysts, and have direct access to the laboratory's QA Manager. Any errors found in this review should trigger appropriate actions resulting in the correction of the data. The secondary review process must be documented in the data package.

In the case of work performed by subcontracted laboratories, the data must be reviewed and approved by the primary laboratory in a manner similar to their secondary review process.

Third Level Review

The third level of review for laboratory data is accomplished by the Laboratory Project Manager during preparation of the final laboratory report. A Case Narrative will be prepared for each data report as documentation of the review. This narrative will include comments as appropriate for the proper interpretation of the data as reported. The signature of the Laboratory Project Manager, Laboratory Director, or designated senior QA staff on each report constitutes acceptance and release of the report from the third-level review.

Compliance Review

A basic compliance review will be conducted by the data assessment manager to ensure completeness and deliverable compliance with method and contractual requirements for each data report submitted by the laboratory. This review will be conducted primarily to confirm contractual compliance by the laboratory and will include the following:

- Comparison of the laboratory work request and chain-of-custody information with the submitted results;
- Verification of holding times for each sample and analytical fraction; and
- Verification of the report's delivery within the contractual window.

Data Acceptability Review

A Data Acceptability Review (DAR) will be conducted by the Parsons data assessment manager on approximately 10 percent of the data reports received from the laboratory. The DAR is intended as a tool to monitor laboratory performance with respect to contract issues and method requirements in a timely manner. This review is intended to be completed and reported within five working days after receipt of data. The results of the DAR report will be communicated to Morton International, Inc. and to the Laboratory Project Manager for immediate action, as needed. The time factor in this review process is important in order to influence laboratory activities while they are still analyzing samples for the project. With this in mind, most of the data reports submitted for a DAR will represent the first ones produced by the laboratory for a given sampling program unit.

The DAR will consist of a checklist review to determine if the data met the program's DQOs. The checklist employed will essentially serve as a portion of the Usability Assessment as described below. At a minimum, the DAR will include: data package completeness review;

review of the CLP-like summary forms to determine if the QC requirements were met for accuracy, precision, and sensitivity; overall review of the data package to determine if contractual and method requirements were met; and review of one sample per fraction to determine if the sample results and quantitation limits were correctly calculated and reported.

The data reviewers will communicate to the Morton International, Inc. Project Manager any data quality problems or issues uncovered during the DAR and will assist in interacting with the laboratory to correct any data omissions and/or deficiencies.

4.9.3 Field Data - Review

The tables and logs compiled by the field team leader and used as the basis for data interpretation, will be checked against the original field documentation by an independent reviewer prior to inclusion in the remedial action report. Parsons is responsible for coordinating and documenting this review activity.

4.9.4 Data Usability Assessment

A data usability assessment (DUA) will be performed by Parsons in compliance with EPA Level 3 specifications under the guidelines set forth in the "EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review", 1999; "EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review", 2004; "Region 2 RCRA and CERCLA Data Validation Standard Operating Procedures (SOPs)", and NJDEP technical requirements, with consideration for the methodology requirements and the site-specific requirements. The DUA will be conducted by Parsons on all data reports for TAL/TCL or reduced Morton International, Inc. analyte list analyses. The data evaluation will include performance and completeness audit and a review of the following parameters: holding times, sample preservations, percentage of solids, QC results of calibration, method blanks, MS/MSD analyses, laboratory control sample performances, field duplicates, surrogate recoveries, instrument performance, chromatograms and mass spectrums, internal standard recovery, and reporting limits. In performing the data validation, the raw data will be spot-checked in accordance with the Region 2 SOPs to evaluate whether there is any transcription error. In addition, the following items will be reviewed during the data usability assessment:

- Chain-of-custody documentation to verify completeness of the data;
- The case narrative discussing analytical problems (if any) and procedures;
- Sample preparation logs or data summary sheets to verify analytical holding times;
- Applicable instrument tuning, instrument calibration, and calibration blank results to assess instrument performance;
- Applicable instrument blanks and method blanks associated with each sample delivery group to check for laboratory contamination;
- Results for all laboratory quality control samples used to check analytical accuracy, including matrix spikes, laboratory control samples (LCSs), and method-specific quality control samples for organic compounds (i.e., surrogate compounds and internal standards) and metals (i.e., interference check samples, serial dilution of field samples, and analytical spikes);

- Results for all quality control samples used to check analytical precision, including duplicate sample analysis for metals, and instrument-specific quality control procedures for metals (i.e., duplicate analyses of all sample digestates); and
- Reporting limits for all target analytes to verify that project requirements were met.

4.9.5 Laboratory Deliverable Format

All analytical results will be reported in the units specified in **Table 4-5**. All soil and sediment results will be reported on a dry-weight basis. The data package deliverable format for analytical data will follow a CLP-like format and will include:

- Title page and table of contents;
- Sample control data;
- Chain-of-custody documents;
- Laboratory work request;
- Air bill;
- Laboratory sample log-in sheets;
- Inter-laboratory sample transfer records;
- Method reference and methodology review;
- Case narrative - nonconformance summary report;
- Analysis data sheet (for each sample);
- Information similar to CLP Form 1;
- Method detection/reporting limit;
- Quality control summary;
- Reagent blank summary;
- Duplicate summary including RPD (when specified);
- MS/MSD summary including percent recovery (when specified;
- Calibration summary;
- Raw QC and standards data;
- Initial calibration data;
- Continuing calibration data (where specified by method);
- Reagent blank data;
- Matrix spike data;
- Duplicate data;
- Raw sample data; and
- Sample preparation (extraction) logs.

4.9.6 Electronic Submission

Diskette deliverables will be required for all laboratory analytical results delivered for the Ventron/Veliscol OU-1 project. These deliverables will be in a project-specific format to facilitate uploading into the project database (EQuIS Data Management System). Laboratory data formatting and delivery protocols will adhere to Morton International Inc. Corporate Remediation Group (CRG) document, “Laboratory Date Reporting Protocol” (Doc. No.: CRG-023). These deliverables will be in a project-specific format to facilitate uploading into the project database. The diskette format and content requirements will be coordinated with the laboratories to facilitate efficiency in the transfer of data.

Any diskette deliverable provided to the project as a modification, revision or update to a previously distributed diskette must be appropriately marked and documented.

The analytical data diskette deliverable received along with the laboratory report (hard copy) deliverable for use in the data review and assessment processes, will be reviewed.

Distribution of Reports and Diskette Deliverables

Parsons will submit field information on a regular basis to the data manager. The laboratory will provide the data validation personnel (Parsons) with the hard copy deliverable and will send the electronic deliverable to the Parsons database manager. After conducting the DAR, the hard-copy report will be forwarded to the Morton International, Inc. Project Manager upon completion of the review. After conducting complete data usability assessments as required, complete final reports will be provided by the data assessment manager to Morton International, Inc.

Project Database

A project database (EQuIS) has been developed to meet users' (e.g., remediation engineers, risk assessors) needs (CRG data management website). This system is designed to maintain and integrate field information (e.g., station location, construction information, sampling team), analytical information (e.g., results, laboratory qualifiers. analysis dates), and data assessment information (e.g., assessment status, qualifiers).

Electronic Submission of Data to NJDEP

The results of environmental sample analysis will be submitted to NJDEP Site Remediation and Waste Management (SRWM) in an electronic format. Every sample point will be geographically referenced using approved accuracy standards. NJDEPs GIS capability requirements can be reviewed at http://www.state.nj.us/dep/gis link to *Digital Data Standards and Guidance for the Submission and Use of Data in GIS Compatible Formats Pursuant to Technical Requirements for Site Remediation* (TECHGIS2) at http://www.state.nj.us/dep/srp/regs/guidence.htm#techgis2. Prior to conducting sampling, the type and format of data that is required to be submitted to SRP as well as other information that will be collected in the field such as geographic location of sampling points will be considered.

Three files will be submitted: HZSAMPLE contains field sampling information; HZRESULT contains analytical results; DTST identifies the data submission. The complete requirements are outlined in detail at http://www.state.nj.us/dep/srp/hazsite. The website will be assessed prior to preparing the data to ensure that the latest requirements are met as the website is updated periodically. Once samples have been collected and data prepared, the data will be run through the "Environmental Data Submittal Application Checking" (EDSA) program to determine compliance with data requirements.

4.10 Corrective Actions

The QA/QC program contained in this section (i.e., QAPP) will enable problems to be identified, controlled, and corrected. Potential problems may involve nonconformance with the sampling and/or analytical procedures established for the project or other unforeseen difficulties. Any persons identifying an unacceptable condition will notify the Parsons Field Team Leader, where applicable, and/or the individual Project Managers. The Project Manager, with assistance from the QA Officer, will be responsible for developing and initiating an appropriate corrective action and verifying that the corrective action has been effective. For laboratory analysis, both the identified deviations and corrective actions will be documented.

4.10.1 Field Corrective Action

Wherever possible, corrective actions will be implemented immediately and documented in the field log book. No other formal documentation will be required unless further corrective action is taken.

Problems that cannot be solved through immediate corrective action will be documented on a Field Corrective Action Form by the person identifying the unacceptable condition. This form identifies the problem, possible causes, and the person responsible for acting on the problem.

The Corrective Action Request form includes a description of the correction action planned, the date it was taken, and space for follow-up. The Parsons Project Manager will check to be sure that initial action has been taken, appears effective, and at an appropriate later date check again to see if the problem has been fully solved. The Morton International, Inc. Project Manager or designee will receive a copy of all Field Corrective Action forms.

Corrective actions may include repeating measurements, resampling, and/or reanalysis of samples, and amending or adjusting project procedures. If warranted by the severity of the problem (e.g., if monitoring wells require resampling or if the project schedule may be affected), the Morton International, Inc. Project Manager will be notified. Additional work that is dependent upon a questionable activity will not be performed until the problem has been eliminated

4.10.2 Laboratory Corrective Action

Nonconformities or discrepancies may be found that affect the validity or quality of analytical data. Corrective actions will be implemented to correct the deficiency or weakness and to identify any analytical data that may have been affected. Wherever possible, immediate corrective action procedures will be employed. Immediate corrective actions taken must be noted in laboratory logbooks, but no other formal documentation is required unless further corrective action is deemed necessary. If a problem persists or cannot be readily identified, a formal corrective action procedure will be initiated. The Laboratory QA Manager shall use this procedure to provide that the condition is documented and tracked until the problem has been fully solved.

A laboratory Corrective Action form will be completed by the person finding the quality problem. This form identifies the problem, possible causes, and the person responsible for acting on the problem. The responsible person may be an analyst, supervisor, or the Laboratory QA Manager. If no person is identified as responsible to implement the corrective action, the Laboratory QA Manager will investigate the situation and determine the course of action for resolution.

Activity	Performed By	Action Officer Receiving Report
Field activity audit (internal)	Parsons	Parsons and Morton International, Inc. Project Managers
Field activity audit (internal)	Parsons/Morton International, Inc.	Parsons and Morton International, Inc. Project Managers
Laboratory audit (internal)	Laboratory	Laboratory QA Officer
Laboratory audit (external)	Morton International, Inc.	Morton International, Inc. Project Manager
Data Compliance Review	Data Assessment Manager	Morton International, Inc. Project Manager
Data Acceptability Review	Data Assessment Manager	Morton International, Inc. Project Manager
Data Usability Assessment	Data Assessment Manager	Parsons and Morton International, Inc. Project Managers

The Corrective Action form includes a description of the corrective action planned, the date it was taken, and space for follow-up. The Laboratory QA Manager will check that initial action has been taken, appears effective, and at an appropriate later date, will check again to see if the problem has been fully solved. Inspection of corrective actions will be performed during laboratory audits.

4.10.3 Variances

Variances from standard, approved field operational procedures and plans will be documented. It is recognized that Workplans cannot possibly foresee all conditions encountered during a field program. A variance is a difference or a partial change in a procedure or plan.

Formal approval of the variance will be given in writing, signed, and dated as approved by the Morton International, Inc. Project Manager, the Parsons QA Officer and/or the Parsons Project Manager, as necessary for the type of variance proposed. The variance should be evaluated to determine if it requires formal approval through NJDEP per N.J.A.C. 7:26E-1.6(d).

All data collection activities will be documented through the use of field log forms and log books. These field records will be reviewed and included in the project file. The QA reports prepared by the analytical laboratory will include the appropriate analytical data, the results of the QC samples, and a description (case narrative) of problems encountered and the corrective action taken. The reports or summaries from these and the other QA reviews, assessments, and audits will be forwarded for action to the appropriate project officer and project files as indicated below.

These QA reports will be reviewed to determine the quality and limitations of the data and to provide feedback to the appropriate operating unit to implement improvements or corrective action immediately or in the future as the individual situation demands.

4.10.4 Field Sampling Changes

In order to provide for personnel and equipment safety and maintain continuity of ongoing work, the following practice for documenting and approving field changes to technical plans and procedures will be used.

Field changes are required and permitted under circumstances wherein failure to approve such a change would:

- Endanger personnel;
- Damage equipment;
- Harm the environment; and/or
- Interrupt collection of irretrievable data.

Field changes may be recommended by any project personnel but will be initially assessed by the Parsons Field Team Leader and communicated to the Parsons Project Manager and QA Officer for approval.

Within five business days of verbally approving a critical field change, a formal written record of the change will be prepared by the Parsons Field Team Leader, QA Officer, or Project Manager, and submitted to the Morton International, Inc. Project Manager or designee.

Section 5 - Health and Safety

Parsons' Health and Safety Plan (HASP) is referenced in **Appendix E**, however, the HASP exists as a separate document. The HASP has been prepared in accordance with Morton International, Inc.'s requirements and Parsons SHARP Manual. The HASP is designed to provide elements necessary for the execution of the pre-design investigation in a concise format which will be readily accessible to the field personnel. The HASP includes information on the following:

- Exclusions zones, decontamination zones, and clean zones (support zones);
- Site access and security;
- Emergency response;
- Action levels;
- Air, dust and noise monitoring;
- Vehicle and traffic safety around the Site;
- Activity Hazard Analyses (AHA);
- Safety personnel; and
- Dust Control.

Section 6 - Schedule and Reporting

Parsons anticipates that the pre-design investigation field activities described above will take approximately 12 weeks to complete. Parsons anticipates initiating the pre-design activities within two weeks of acceptance of the workplan by Morton International, Inc.. Since the activities will be performed mainly during the winter months, the sequence of the events will be determined based on the weather conditions. Access due to deed restrictions or scheduling may also warrant modifications to the schedule.

Following the completion of the pre-design investigation program and laboratory testing, Parsons will compile the information in a Pre-Design Investigation Memorandum and submit it to Morton International, Inc. for review. The information presented in the memorandum will be used in the design phase of the remedial actions. The report will contain the following information:

- Summary of the scope and methods of the work completed;
- Description of the subsurface conditions encountered, including nature and thickness of fill soils and native materials encountered, and the nature and extent of any apparently impacted materials observed;
- Summary of laboratory analytical results for the soil samples collected;
- Summary of geotechnical laboratory testing program;
- Wetland assessment findings;
- Boring, test pit, and hand auger logs;
- Barrier wall cross-sections based on the newly collected information; and
- Conclusions and recommendations for future actions, as appropriate.

Section 7 - References

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United States Geological Survey website.

Table 2-1 Pre-Design Investigation Tasks vs. Selected Remedial Measure Components
Morton International, Inc.
Ventron/Velsicol Superfund Site Operable Unit-1
Wood-Ridge and Carlstadt, New Jersey

Pre-Design Task	Remedial Components											
	Vertical Hydraulic Barrier System	**Vertical Wall Barrier Soils**	**CEA and WRA Development**	**Groundwater Monitoring**	**Soil Excavation >620 mg/kg**	**Excavation of Property Lin-Mor**	**Capping & Maintenance of Existing Cap**	**Soil Excavation 55 ft buffer area**	**Excavation of West Ditch**	**Location of Discharge Pipe**	**Deed Notices**	**Contaminated Flux**
Utility clearance / mark-out	X				X		X		X			
Visual inspection of asphalt and building foundations	X					X	X					
Site survey	X	X	X		X		X	X	X	X		
Geotechnical soil borings	X	X		X	X		X					
Mercury delineation borings in developed area					X							
Hand augers							X	X				
Test pits	X	X		X			X			X		
Groundwater measurements	X			X				X	X			
Wetland assessment								X				

Table 3-1 Location of Pre-Design Investigation Tasks
Morton International, Inc.
Ventron/Velsicol Superfund Site Operable Unit-1
Wood-Ridge and Carlstadt, New Jersey

Pre-Design Task	Properties Owners and Lot Numbers											
	Julius Blum & Company	Prince Packing	U.S. Life Warehouse	Wolf Ware - house	EJB Holding	Lin-Mor	Former POTW	Undeveloped Area	Randolph Products	Ethel Blvd	Norfolk Southern Rail Spur	Diamond Shamrock / Henkel
	Block 229, Lot 1	Block 229, Lot 2	Block 229, Lot 10.01	Block 229, Lot 10.02	Block 229.01 Lot 11	Block 229, Lot 4.02	Block 229, Lot 4.02	Block 229, Lot 8 and Block 84, Lot 5				
Utility clearance / mark-out			X	X	X	X		X		X		
Visual inspection of asphalt and building foundations			X	X	X	X		X		X	X	
Site survey	X	X	X	X	X	X	X	X	X	X	X	X
Geotechnical soil borings			X	X				X		X		
Mercury delineation borings in developed area			X	X						X		
Hand augers			X	X				X		X		
Test pits			X	X				X				
Groundwater measurements			X	X				X		X		
Wetland assessment								X				

Table 3-2 Sampling Summary for Mercury Delineation in Developed Area
Morton International, Inc.
Ventron/Velsicol Superfund Site Operable Unit-1
Wood-Ridge and Carlstadt, New Jersey

Area	Loc ID	Sample Depth (ft bgs) (1)	Analytical Parameter	Analytical Method	Comments(2) (3)
A	P-SB-A1	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Archive at lab
	P-SB-A2	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Archive at lab
	P-SB-A3	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Archive at lab
	P-SB-A4	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Archive at lab
B	P-SB-B1	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Archive at lab
	P-SB-B2	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Archive at lab
	P-SB-B3	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Archive at lab

Table 3-2 Sampling Summary for Mercury Delineation in Developed Area
Morton International, Inc.
Ventron/Velsicol Superfund Site Operable Unit-1
Wood-Ridge and Carlstadt, New Jersey

Area	Loc ID	Sample Depth (ft bgs) (1)	Analytical Parameter	Analytical Method	Comments(2) (3)
C	P-SB-C1	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Archive at lab
	P-SB-C2	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Archive at lab
	P-SB-C3	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Archive at lab
	P-SB-C4	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Archive at lab
D	P-SB-D1	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB- D2	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D3	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab

Table 3-2 Sampling Summary for Mercury Delineation in Developed Area
Morton International, Inc.
Ventron/Velsicol Superfund Site Operable Unit-1
Wood-Ridge and Carlstadt, New Jersey

Area	Loc ID	Sample Depth (ft bgs) (1)	Analytical Parameter	Analytical Method	Comments(2) (3)
	P-SB-D4	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D5	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D6	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D7	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D8	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D9	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab

Table 3-2 Sampling Summary for Mercury Delineation in Developed Area
Morton International, Inc.
Ventron/Velsicol Superfund Site Operable Unit-1
Wood-Ridge and Carlstadt, New Jersey

Area	Loc ID	Sample Depth (ft bgs) (1)	Analytical Parameter	Analytical Method	Comments(2) (3)
	P-SB-D10	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D11	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D12	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D13	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D14	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D15	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab

Table 3-2 Sampling Summary for Mercury Delineation in Developed Area
Morton International, Inc.
Ventron/Velsicol Superfund Site Operable Unit-1
Wood-Ridge and Carlstadt, New Jersey

Area	Loc ID	Sample Depth (ft bgs) (1)	Analytical Parameter	Analytical Method	Comments(2) (3)
	P-SB-D16	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D17	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D18	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D19	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D20	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D21	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab

Table 3-2 Sampling Summary for Mercury Delineation in Developed Area
Morton International, Inc.
Ventron/Velsicol Superfund Site Operable Unit-1
Wood-Ridge and Carlstadt, New Jersey

Area	Loc ID	Sample Depth (ft bgs) (1)	Analytical Parameter	Analytical Method	Comments(2) (3)
	P-SB-D22	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab
	P-SB-D23	0-0.5	Mercury	Method 7174A	Analyze
		1-1.5	Mercury	Method 7174A	Archive at lab
		2-2.5	Mercury	Method 7174A	Analyze
		3-3.5	Mercury	Method 7174A	Archive at lab
		4-4.5	Mercury	Method 7174A	Analyze
		5-5.5	Mercury	Method 7174A	Archive at lab

Notes:
1) Samples will not be collected if interval falls below the water table.
2) Two day turn around at the laboratory is required for the mercury analysis.
3) Archived samples have a maximum holding time of 28 days for mercury analysis.

Table 4-1 Data Quality Objectives and Analytical Levels
Morton International Inc.
Ventron/Veliscol Superfund Site Operable Unit 1
Wood-Ridge and Carlstadt, New Jersey

Data Collection Activities	Media	Approx. No. Samples[1]	Parameter Group[2]	Parameters	DQO Level[3]	Field Method	Analytical Method[3]	Objectives / Rationale
Mercury Delineation	Soil	TBD	Field Measurements	Total Mercury	Level I	Grab sample from split spoon sampler (ASTM D1586)	XRF Portable Analyzer (Niton or similar)	Delineate and determine degree of correlation between field and lab results
	Soil	TBD	Site-Related Soil Contaminants[4]	Total Mercury	Level III	Grab sample from split spoon sampler (ASTM D1586)	SW-846	Delineate and determine degree of correlation between field and lab results

Notes:
1. Number of samples to be determined during pre-design investigation and remedial action activities.
2. The site-specific analyte lists are provided in separate tables along with target reporting limits.
3. The methods are EPA methods unless otherwise indicated. Complete method references are provided in separate tables.
4. Site-Related soil and ground water contaminants defined in ROD, signed October 30, 2006.

Table 4-2 Mercury Soil Remediation Goals
Morton International Inc.
Ventron/Veliscol Superfund Site Operable Unit 1
Wood-Ridge and Carlstadt, New Jersey

Compound	RDCSCC (mg/kg)	NRDCSCC (mg/kg)
Mercury	14	270

Table 4-3 Quality Control Sampling Frequency
Morton International Inc.
Ventron/Veliscol Superfund Site Operable Unit 1
Wood-Ridge and Carlstadt, New Jersey

QC Samples	Non-Aqueous	Aqueous
Field Rinsate Blank	1 per 10 samples or 1 per day (whichever is less)	1 per day
Trip Blank	None	1 per shipment[1]
Field Duplicates	1 per 20 samples[2]	1 per 20 samples[2]
MS/MSD	1 per 20 samples[2]	1 per 20 samples[2]
Temperature Blank	Each Cooler	Each Cooler

Notes:

1. Not to exceed 2 consecutive field days
2. Samples collected 1 per sample matrix if less than 20 samples are to be collected.

Table 4-4 Sample Collection Information
Morton International Inc.
Ventron/Veliscol Superfund Site Operable Unit 1
Wood-Ridge and Carlstadt, New Jersey

Matrix	Parameter	Sample Container(s) [1]	Preservative	Holding Time
Soil	Mercury	125-mL wide mouth HDPE bottle	Cool, 4^{o}C	Mercury - 26 days from VTSR (28 days from VTOS)

Note:

1. The sample containers may be combined as needed in cases where the container materials, preservative, and sample handling instructions do not conflict and where a single laboratory is performing the combined analyses

2. Abbreviations

VTSR	Verified time of sample receipt
VTOS	Verified time of sampling
mL	Milliliter

Table 4-5 Quality Review Parameters
Morton International Inc.
Ventron/Veliscol Superfund Site Operable Unit 1
Wood-Ridge and Carlstadt, New Jersey

Matrix	Parameter	Method	Units	MDL[1]	PQL/IDL	Bias (percent)[2]	Precision (RPD)[2]	Completeness
Soil	Total Mercury	SW-846 method 7471 EPA	mg/kg	-	0.02	75-125	20	95

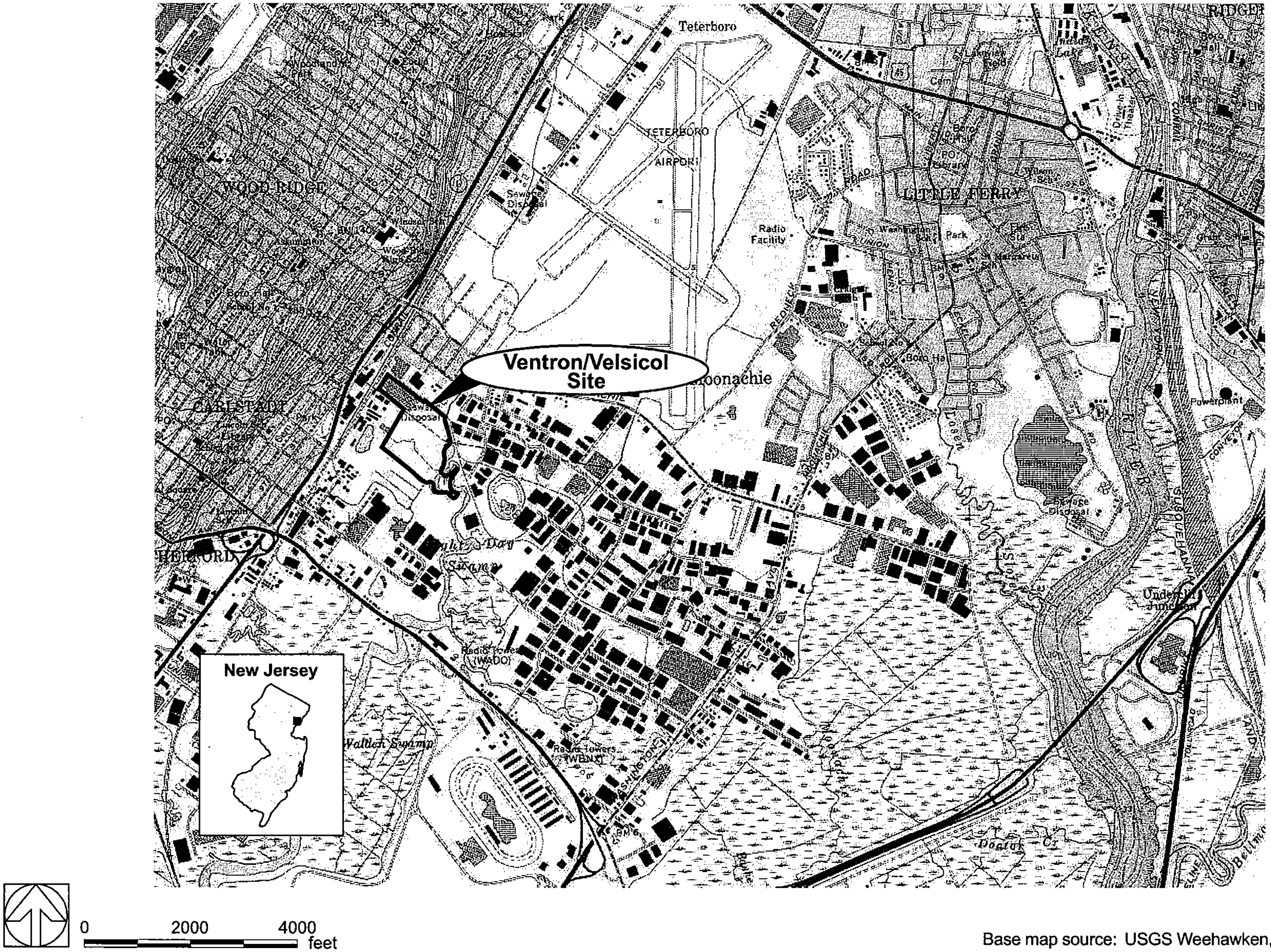
Notes:

1. Metals are reported to the IDL.

2. The values listed for bias and precision are the ranges listed per the referenced method or what can routinely be achieved by and analytical laboratory.

3. Abbreviations

MDL	Method Detection Limit
PQL	Practical Quantitation Limit
IDL	Instrument Detection Limit
RPD	Relative Percent Difference



Base map source: USGS Weehawken, NJ-NY quadrangle

Figure 1 Site location map.

NOTES:

1. BASEMAP OBTAINED FROM MASER CONSULTANTS, INDEX NUMBER HASU007732, DATED 7/28/05.
2. THE HORIZONTAL POSTIONS ARE BASED ON NAD 83 COORDINATES DERIVED FROM G.P.S. OBSERVATIONS UTILIZING BASE STATIONS NJ12, P.I.D. AJ3348; SHK1, P.I.D. AF9509 AND LAMT, P.I.D. AJ4872.
3. THE ELEVATIONS SHOWN ARE BASED ON NGVD29 DATUM AND DERIVED FROM DIFFERENTIAL LEVELING METHODS UTILIZING TIDAL BENCH MARK 853-0436 1-1, P.I.D. KV3467 AND TIDAL NECH MARK 853-0436 1-2, P.I.D. KV3469.

LEGEND:

- PROPOSED VERTICAL HYDRAULIC BARRIER ALIGNMENT
- PROPOSED SINGLE LAYER CAP FROM ROD
- PROPOSED STAGING AND DECON AREA
- PROPOSED MERCURY EXCAVATION AREAS
- P-SB-17 PROPOSED PARSONS BORING LOCATIONS
- B-1 PREVIOUS BORING LOCATIONS
- MW-12 EXISTING MONITORING WELL (NJDEP, 1990 & 1991)
- MW-15 EXISTING MONITORING WELL (EXPONENT, 1999)
- RAILROAD TRACKS
- BOLLARDS
- UTILITY POLE W/LIGHT
- FIRE HYDRANT
- UTILITY POLE
- UTILITY MANHOLES
- CB CATCH BASIN (CB)

80 40 0 80 160

SCALE: 1" = 80'

DRAFT
NOT FOR CONSTRUCTION

MORTON INTERNATIONAL, INC.
100 INDEPENDENCE MALL WEST
PHILADELPHIA, PA 19106-2399

NO.	REVISION	BY	APPR.	APPR.	APPR.	DATE	REFERENCE	DWG. NO.
	PRE-DESIGN INVESTIGATION WORKPLAN	RR	CMG	PGB	RES	12/04/06		
1	PRE-DESIGN INVESTIGATION WORKPLAN	RR	CMG	PGB	RES	1/05/07		

JOB NO. 442859
CONTRACTOR'S JOB NO.
SCALE AS SHOWN

VENTRON/VELSICOL SUPERFUND SITE OU-1
WOOD-RIDGE/CARLSTADT, NEW JERSEY
PROPOSED GEOTECHNICAL SOIL
BORING LOCATION PLAN

PARSONS
100 COTTONTAIL LANE
SOMERSET, NJ 08873-1148

RR	11/01/06	CMG	11/01/06
DRAWN	DATE	CHK.	DATE

LOCATION | SHEET NUMBER: FIGURE 2 | REV: 1

BOS. FILE LOCATION: P:\PIT\Projects\Rohm & Haas\OU-1\Drawings\Pre-Design Investigation\Final\Figure 2.dwg

MORTON INTERNATIONAL, INC.
100 INDEPENDENCE MALL WEST
PHILADELPHIA, PA 19106-2399

NO.	REVISION	BY	APPR.	APPR.	APPR.	DATE	REFERENCE	DWG. NO.
	PRE-DESIGN INVESTIGATION WORKPLAN	RR	CMG	PGB	RES	12/04/06		
1	PRE-DESIGN INVESTIGATION WORKPLAN	RR	CMG	PGB	RES	1/05/07		

JOB NO. 442859
CONTRACTOR'S JOB NO.
SCALE AS SHOWN

VENTRON/VELSICOL SUPERFUND SITE OU-1
WOOD-RIDGE/CARLSTADT, NEW JERSEY
PROPOSED TEST PIT AND
HAND AUGER LOCATION PLAN

PARSONS
100 COTTONTAIL LANE
SOMERSET, NJ 08873-1148

RR	11/01/06	CMG	11/01/06
DRAWN	DATE	CHK.	DATE

LOCATION | SHEET NUMBER: FIGURE 3 | REV: 1

BOS. FILE LOCATION: P:\PIT\Projects\Rohm & Haas\OU-1\Drawings\Pre-Design Investigation\Final\Figure 3.dwg

LEGEND:

- P-SB-A1 PROPOSED PARSONS DELINEATION BORING (PRELIMINARY)
- PROPOSED PARSONS DELINEATION BORING (SECONDARY)
- SS-04 EXISTING SAMPLE LOCATION
- ESTIMATED EXCAVATION LIMITS FROM FEASIBILITY STUDY

30 15 0 30 60

SCALE: 1" = 30'

DRAFT
NOT FOR CONSTRUCTION

MORTON INTERNATIONAL, INC.
100 INDEPENDENCE MALL WEST
PHILADELPHIA, PA 19106-2399

NO.	REVISION	BY	APPR.	APPR.	APPR.	DATE	REFERENCE	DWG. NO.
	PRE-DESIGN INVESTIGATION WORKPLAN	RR	CMG	PGB	RES	12/04/06		
1	PRE-DESIGN INVESTIGATION WORKPLAN	RR	CMG	PGB	RES	1/05/07		

JOB NO. 442859
CONTRACTOR'S JOB NO.
SCALE AS SHOWN

VENTRON/VELSICOL SUPERFUND SITE OU-1
WOOD-RIDGE/CARLSTADT, NEW JERSEY
PROPOSED MERCURY DELINEATION
BORING LOCATIONS

PARSONS
100 COTTONTAIL LANE
SOMERSET, NJ 08873-1148

RR	11/01/06	CMG	11/01/06
DRAWN	DATE	CHK.	DATE

LOCATION | SHEET NUMBER FIGURE 4 | REV 1

BOS. FILE LOCATION: P:\PIT\Projects\Rohm & Haas\OU-1\Drawings\Pre-Design Investigation\Final\Figure 2.dwg

APPENDIX A – FIELD FORMS

APPENDIX A-1 – SAMPLE SOIL BORING LOG

Soil Boring Log

CLIENT: Morton International, Inc.	**INSPECTOR:**		**BORING/WELL NO.**
PROJECT NAME: Ventron/Velsicol OU-1 Site	**DRILLER:**		**LOCATION DESCRIPTION**
PROJECT LOCATION: Woodridge/Carlstadt, New Jersey	**WEATHER:**		
PROJECT NUMBER: 442859	**CONTRACTOR:**		
GROUNDWATER OBSERVATIONS	**RIG TYPE:**		**LOCATION PLAN**
	DATE/TIME START:		
WATER LEVEL:	**DATE/TIME FINISH:**		
DATE:	**WEIGHT OF HAMMER:**	140 #	
TIME:	**DROP OF HAMMER:**	30 inches	
MEAS. FROM:	**TYPE OF HAMMER:**	Automatic	

SAMPLE DEPTH	SAMPLE I.D.	BLOWS per 6"	ADV/ REC.	PID (ppm)	FIELD IDENTIFICATION OF MATERIAL	STRATA	COMMENTS
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							
0							
					BOTTOM OF BORING		

Remarks:

Sample Types	Consistency vs. Blowcount / Foot		
	Granular (Sand & Gravel)	Fine Grained (Silt & Clay)	
S -- Split Spoon	V. Loose: 0-4 Dense: 30-50	V. Soft: <2 Stiff: 8-15	and - 35 -50%
U -- Undisturbed Tube	Loose: 4-10 V. Dense:: >50	Soft: 2-4 V. Stiff: 15-30	some - 20-35%
C -- Rock Core	M. Dense: 10-30	M. Stiff: 4-8 Hard: > 30	little - 10-20%
A -- Auger Cuttings			trace - <10%
			moisture, density, color, gradation

APPENDIX A-2 – SAMPLE TEST PIT LOG

Test Pit Field Log

CLIENT:	Morton International, Inc.	**INSPECTOR:**	
PROJECT NAME:	Ventron/Velsicol OU-1	**CREW:**	
PROJECT LOCATION:	Wood-Ridge and Carlstadt, New Jersey	**WEATHER:**	
PROJECT NUMBER:	442859	TEST PIT NO:	
DATE:		GROUND ELEV:	

TEST PIT DATA

LENGTH	WIDTH	DEPTH	EXCAVATION METHOD

CONTRACTOR:

START DATE:

COMPLETION DATE:

CHECKED BY:

MONITORING DATA

INSTRUMENT	DETECTOR	BACKGROUND	TIME/DATE

REMARKS:

LOCATION SKETCH:

North

NTS

DEPTH (FT)	VOC	SAMPLE NO.	SAMPLE DEPTH	STRATA	SAMPLE DESCRIPTION (As per Burmeister: wetness, consistency, color, MAJOR COMPONENT with grain size and Minor Components with amount modifiers; trace = 1 to 10 %, little = 10 to 20%, some = 20 to 35%, and = 35 to 50 %)	EXCAVATION EFFORT E - Easy M - Moderate D - Difficult
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

APPENDIX A-3 – SAMPLE COC FORM

Analysis Request/Chain of Custody

For Parsons use only

Date Results Received: ______________ Requested TAT Met: Yes / No

Parsons PM Signature ____

For Laboratory use only

Acct. #: ____________ Sample #: ______________________________ SCR#: ____________________

PARSONS

Project Mgr.: Robert Strahle

Project Name: Ventron Velsicol

Project Charge Code:

Sampler: ______________________

Report To: ______________________

State of Origin: New Jersey

Analyses Requested List total number of containers in the box under each analysis.

Preservation Codes

Preservative Codes

H = HCl **T** = Thiosulfate
N = HNO_3 **B** = NaOH
S = H_2SO_4 **O** = Other

☑ J value reporting needed.

***** Specify special detection limits/reporting lists below.

TPH = 50 ppb
VOCs = 0.5 ppb
MTBE = 1.0 ppb

Sample Identification	Date Collected	Time Collected	Grab	Composite	Matrix: Soil	Matrix: Water (☐ Potable ☐ NPDES)	Matrix: Oil ☐ Air ☐	Total Number of Containers															

Turnaround Time Requested (TAT) (please circle)

STD. TAT 72 hour 48 hour
24 hour 4 day 5 day

Data Package Options (please circle if required)

QC Summary Type I - Full
Type VI (Raw Data) Disk / EDD
WIP (RWQCB) Standard Format
Disk ___________ Other.

Relinquished by: Field Sampler	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by Commercial Carrier: UPS FedEx Other____________________			Received by:	Date	Time
Temperature Upon Receipt__________ C°			Custody Seals Intact? Yes No		

APPENDIX A-4 – SAMPLE VISUAL INSPECTION FORM

Visual Inspection Check List

CLIENT:	Morton International, Inc.	**DATE:**	
PROJECT NAME:	Ventron/Velsicol OU-1	**INSPECTOR:**	
PROJECT LOCATION:	Woodridge/Carlstadt, New Jersey	**CREW:**	
PROJECT NUMBER:	442859	**WEATHER:**	
LOCATION:			

ITEM	CONDITION				GENERAL COMMENTS
	GOOD[1]	SATIS.[2]	POOR[3]	N/A	
Surface condition					
Cracks on Asphalt					
Cracks in Foundation					
Pot Holes					
Tire Ruts/Uneven surfaces					
Ponding Areas					
Other					

Sketch

Notes:
1) Item found to be in good working conditon and will not require any repair or maintenace in the near future.
2) Item found to be in satisfactory condition but might require repair or maintenance in the near future.
3) Item found to be in poor woking conditon and requires repair immediately.

APPENDIX A-5 – GROUNDWATER ELEVATION RECORD

Groundwater Elevation Record

CLIENT: Morton International, Inc.
PROJECT NAME: Ventron/Velsicol OU-1
PROJECT LOCATION: Woodridge/Carlstadt, New Jersey
PROJECT NUMBER: 442859

DATE:
INSPECTOR:
CREW:
WEATHER:

Liquid Indicator:

Note: all depths measured from marked location on riser

Well ID	Time	Depth to Water	Well Elevation (top of riser)	Ground Water Elevation	Depth Bottom of Well	Corrected Ground Water Elevation	Comments

APPENDIX B – SOIL CLASSIFICAION

APPENDIX B-1 – BURMESITER CLASSIFICATION

EXHIBIT F

BURMEISTER CLASSIFICATION SYSTEM

The following identification system is an adaptation of the Burmeister Classification System. The dominating identification criteria is based upon the soils grain size. Components of the sample description consist of the following items in this specific order of description:

1. Moisture Content
2. Consistency
3. Color
4. Soil Class Predominating (grain size) with secondary entry if applicable

Example: Wet, medium dense, brown, fine to medium sand, some fine gravel.

1. Moisture Content: The relative moisture content of the soil at the time of sampling shall be designated as: "dry," "moist," or "wet."

2. Consistency: The consistency of the soil sample shall be described as follows:

Fine-grained soils: "Stiff," "medium stiff," or "soft," as well as designation of whether the soil is "plastic" or "nonplastic." Fine-grained soils are those having predominance of silt and/or clay.

Coarse-grained soils: "Loose" or "medium dense" or "dense" and a designation as to whether or not the soil is "cemented." Coarse-grained soils are those having a predominance of gravel and/or sand.

Also, in coarse-grained soils, the shape of the grain shall be identified and indicated as: "flat," "angular," and/or "round." The overall grading of the material shall be designated as: "well-graded," "poorly-graded," or if the material is noticeably of one size, it should be designated "uniform."

PENETRATION GUIDE

Sand		Clay	
Very loose	0-4 Blo/ft	Very soft	<2 Blo/ft
Loose	4-10 Blo/ft	Soft	2-4 Blo/ft
Medium dense	10-30 Blo/ft	Medium stiff	4-8 Blo/ft
Dense	30-50 Blo/ft	Stiff	8-15 Blo/ft
Very dense	50+ Blo/ft	Very stiff	15-30 Blo/ft
		Hard	30+ Blo/ft

3. Color: The predominant color of the soil sample in the natural state shall be designated as: "white," "brown," "yellow," "red," "gray," "blue," or "black." In some cases, the soil (especially clay) may be "mottled" and contain several color variations (i.e., "blue/gray mottled clay").

4. Grain Size: On the basis of grain size, soils are divided into four classes: gravel, sand, silt, and clay. Gravel and sand should be further designated as coarse or fine. For guidance, the limits of grain size (in millimeters) of each class of material are as follows:

Soil	From Sieve No.	mm.	To Sieve No.	mm.
Gravel - coarse	3"	75	3/4"	19.0
- fine	3/4"	19	#4	4.75
Sand - coarse	#4	4.75	#10	2.0
- medium	#10	2.0	#40	0.425
- fine	#40	0.420	#200	0.075
Silt	#200	Material passing the No. 200 sieve which is usually non-plastic in character and exhibits little or no strength when air dried.		
Clay	#200	Material passing the No. 200 sieve which can be made to exhibit plasticity within a certain range of moisture contents and which exhibits considerable strength when air dried.		

Several entries are made to describe a soil according to grain size:

<u>The first entry</u> represents the predominating type of soil contained in the sample. This should be capitalized in each case, such as "sand."

<u>The second entry</u> indicates the second and/or third component material. The amount of this material should be indicated by the consistent use of the following words:

"and"	- 50 to 35% of the secondary component
"some"	- 35 to 20%
"little"	- 20 to 10%
"trace"	- 10 or less

Ro

A typical entry would read: Silt, some fine sand, trace of clay, for a sample which is largely silt with about 30 percent of fine sand and about 5 percent of clay.

Other examples:

Fine Sand, some silt, ~~and~~ clay
Silt, trace ~~of~~ fine sand, ~~and~~ clay
Silt, some coarse sand, ~~and~~ gravel

5. Other Designations

Vegetable and Muck and Peat - Vegetable mucks and peats are soil mixtures with varying percentages of organic and vegetable matter formed by decomposition of leaves, grasses, and other fibrous materials. The color ranges from light brown to black. The soil content of the mixture should be identified and an estimate made of the amount of vegetable matter in the mixture. When the mixture contains a high percentage of vegetable material, it is called peat. The vegetative matrix comprising the peat should be further identified as "fibrous" or "woody." The sample composition should be further described as to texture, either "cake-like," "spongy," or predominantly "granular."

Miscellaneous - Certain materials may be incorporated which do not fall under the foregoing classifications and which require further qualification for proper identification. Additional terms may be used, but should not replace the basic description. These additional terms may be used specifically designate the material as "rock fragments," "stones," "rock flour," or other qualifying descriptions.

Field Observations to Identify Silt and Clay Characteristics - The field test listed in the table below may be used to distinguish between the structural characteristics of a silt or clay soil.

Characteristics	Silt	Clay
Plasticity in the moist state	Very little or no plasticity.	Plastic and sticky and can be rolled.
Cohesiveness in dry state	Little or no cohesive strength dry state and will slake readily.	Has a high dried strength. Crumbles with difficulty, slakes slowly in water.
Visual inspection and feel	Coarse silt grains can be seen. Silt feels gritty when rubbed between the fingers.	Clay grains cannot be observed by visual inspection. They feel smooth and greasy when rubbed between fingers.
Settlement in water	Will settle out of suspension within one hour.	Will stay in suspension in water for several days unless it flocculates.
Movement of water in the voids	When a small quantity of silt is shaken in the palm of the hand, water will appear in the surface of the soil. When shaking is stopped, water will gradually disappear.	When a small quantity is shaken in the palm of the hand, it will show no signs of water moving out of the voids.

If the fine-grained soil is a mixture of silt and clay, the tests indicate whether or not the predominating characteristics of the mixture is of silt or clay.

APPENDIX B-2 – USCS CLASSIFICATION (ASTM D2488)
(To be provided in field)

APPENDIX C – SHELBY TUBE SAMPLING GUIDELINES

SUBSURFACE SOIL SAMPLES FROM SHELBY TUBES

Subsurface soil samples for permeability, consolidation, UU and CUI triaxial tests will be collected using Shelby tubes. The following techniques will be used:

- Inspect Shelby tube prior to sampling. The tube should be free of rust and dents, have a smooth inner seam, and a smooth, sharp cutting edge.
- Attach a Shelby tube sampler to the drill rods.
- Lower the Shelby tube sampler to the bottom of the boring.
- Push the Shelby tube sampler 2 feet into the undisturbed soil at a constant rate without rotating. Do not overpack the sampler.
- Allow the tube to remain in the boring hole without rotating for 5 to 15 minutes depending on the soil conditions to allow the build up of skin friction prior to removal.
- The sampler will then be rotated one or two revolutions to shear the sample from the soil below and carefully removed from the borehole.
- Both ends of the sample will be sealed in the sampler with wax. (Note: Care should be taken when placing wax on samples that may allow hot wax to penetrate into the sample, i.e. porous material. Wax should be at the point of hardened or mixed with a bulking material, i.e. oil, to prevent infiltration, before placement)
- Label the Shelby tube for sample ID and vertical orientation.
- Store sample in the upright position in a place where it will not be subject to vibrations, sudden shock, drying out, or temperature below 32°F.
- If approximately 2 feet of sample is recovered, sampling is complete. If less than 18 inches of recovery is obtained, attempt to collect another sample from the next 2-foot interval
- ASTM D1587 to be provided in field.

APPENDIX D – ROHM AND HAAS SAMPLING NOMENCLATURE GUIDELINES

DOCUMENT INFORMATION SHEET

1. **TITLE:** CRG Naming Conventions

2. **CLASSIFICATION (Check where appropriate)**

☒	Administrative	☐	Safety Related
☒	Field Work Related	☒	Analytical Lab Related
☒	Data Management & EQuIS Related	☐	GW Monitoring Related

3. **DOCUMENT TYPE**

☒	Procedure	☒	Guidance	☒	CRG Specifications	☐	Document Format

4. **ISSUE DETAILS**

a)	Department Name:	Remediation Dept. No.: 70010601		
b)	Electronic File Name:	CRG-026a.doc		
c)	Original Issue Date:	17 Aug 2003		
d)	Document Number:			
e)	Version Number:	1		
f)	Version Issue Date:	17 Aug 2003		
g)	Review Date: (date of next required review)			
h)	Obsolete Issue Removed by:		Date:	

5. **AUTHORIZATION (As appropriate)**

	Signature	Date	Job Title
Written By:	Paul Cichy	17 Aug 2003	Technical Fellow
Approved By:			

6. **DISTRIBUTION LIST (include job function) * See Attached List**

Title: CRG Naming Conventions **Doc. ID: CRG-026a.doc**

REVISION LOG

VERSION NO.	REASON FOR CHANGE(S)	DATE
1	Extracted from CRG-026 and expanded to cover naming conventions other than just field samples.	17 Aug 2003

FORM Revised 8/11/03 by PTC

CRG Naming Conventions

Code Specification - Field Generated Samples

The Code assigned to a Sample at the time it is collected is a critically important part of the data management system and therefore should conform to the following specification.

The code must be unique and contain the following six (6) items.

[date location depth preservation filtration type]

-The date: use the format "YYYYMMDD"
("YYYY"=four-digit year, "MM"=two-digit month, and "DD"=two-digit day)

20020103 for 3 January 2002

This form of the date is used so that samples will sort chronologically.

-The location: use the location code that has been assigned to the location where the sample was taken e.g. MW-21 (see restrictions below)

-The depth at which the sample was taken:
- --for wells, use the depth in the well where the pump inlet was located prefixed with a "V" for Vertical e.g. V25
- --for soil samples use the "V" prefix followed by the sampled range e.g. V2-4
- --for samples from wells where the vertical depth of the sample is not known, use the "V" prefix followed by the depth of the midpoint of the screened interval followed by the character "@" e.g. V34@. The @ symbol indicates that the depth was derived and is not a measured value.

-The use of preservation:
- --for samples that would normally be preserved, such as VOA samples and metals samples, but where it is desired to collect an unpreserved sample, indicate that the sample is unpreserved by including the character "U" in the sample code immediately after the depth entry.
- --for samples that would normally be unpreserved, such as SVOC samples, but where it is desired to collect a preserved sample, indicate that the sample is preserved by including the character "P" in the sample code immediately after the depth entry.

-The use of filtration:
if the sample is filtered, place a "D" in the code immediately in front of the sample type to indicate that the sample contains only Dissolved components.

-The sample type: e.g. "N" for a normal environmental sample

(see Table 1 below for other sample type codes)

Restrictions:

Currently the sample code is limited to 40 characters by a field length limitation in the EQuIS database. If you construct a sample code and it exceeds the 40 character limit, contact CRG to determine how to contract the sample code while assuring that the code remains unique. Refrain from using spaces in the code and use dashes only in the location code and depth range.

Experience has shown that certain characters cause a problem with lab LIMS data systems and therefore should not be used in the location codes or the sample codes. (see the list below)

The following characters must not be present in the sample code:

<table>
<tr><td>ampersand</td><td>&</td><td>back quote</td><td>`</td></tr>
<tr><td>backslash</td><td>\</td><td>dollar sign</td><td>$</td></tr>
<tr><td>double quotes</td><td>"</td><td>pipe or vertical bar</td><td>|</td></tr>
<tr><td>semi colon</td><td>;</td><td>single quotes</td><td>'</td></tr>
<tr><td>colon</td><td>:</td><td>any parenthesis or brackets</td><td>{ }, ( ), [ ]</td></tr>
<tr><td>forward slash</td><td>/</td><td>asterisk</td><td>*</td></tr>
<tr><td>greater than</td><td>></td><td>lest than</td><td><</td></tr>
<tr><td>question mark</td><td>?</td><td>curly quotes</td><td>“ ”</td></tr>
</table>

Note: This limitation on acceptable characters is the principal reason that the previous convention of placing parentheses around the depth was replaced with the current convention of using a “V” prefix. (PTC, 2/1/02)

Normal "Field" Samples

Examples of Some Typical Sample Codes

-A NORMAL environmental sample from well MW-21 from a depth of 25 feet on 3 Jan 2002.

20020103MW-21V25N

Note: Depth numbers should be reported in the depth unit typically used at the site i.e. feet when measurements are in feet, meters when the measurements are in meters.

-A pair of NORMAL environmental samples, one that contains the normal preservative called for by the usual sampling procedure and the other in which the preservative has intentionally not been added.

20020103MW-21V25N with normal preservative
20020103MW-21V25UN without preservative

-A NORMAL environmental sample that has been filtered.

20020103MW-21V25DN

-A NORMAL environmental sample where the preservative which is normally added has NOT been added and the sample has been filtered.

20020103MW-21V25UDN

-A NORMAL environmental soil sample taken from the depth interval of 2 to 4 feet at soil sample location SS-34.

20020103SS-34V2-4N

-An historical NORMAL environmental sample taken from a well but where the sample depth was unknown. The depths to the top/bottom of the well screen was 10/20.

20020103MW-21V15@N

"Field" Quality Control Samples

The following sample types relate to Quality Performance by the "Lab" and are covered under the heading "Lab Quality Control Samples":

Trip Blanks	Method Blanks
Blind Samples	Blank Spikes
Matrix Spikes	Blank Spike Duplicates
Matrix Spike Duplicates	Lab Control Samples
Lab Replicates	Surrogates
	Internal Standards

Field Duplicates

A field duplicate is given the same code as the normal sample except that the designation “FD” is used instead of “N”.

20020103MW-21V25FD

Field Blanks

Field Blanks are labeled with the date, site code, and the designation “FB”.

20020103LTGFB.

When there is more than one field blank for a given day, a unique sequence number should be added.

20020103LTGFB-1

Equipment Blanks

Equipment Blanks are labeled with the date, the site code (for example LTG for the Lauterbourg, France site. See Table 2 below.), and the suffix "EB".

20020103LTGEB

If there were more than one Equipment Blank for a given day, a unique sequence number should be added.

20020103LTGEB-1

Rinse Water

Rinse Water samples are labeled with the date, the site code (for example LTG for the Lauterbourg, France site. See Table 2 below.), and the suffix "RW".

20020103LTGRW

Well Construction Materials

Samples of materials used in the boring and installation of a well are labeled with the date, the site code (for example LTG for the Lauterbourg, France site. See Table 2 below.), and the suffix "MB". These materials include drilling muds, drilling water, grout, cement, sand, etc.

20020103LTGMB

Lab Sample Designation

Each lab has its own system for identifying samples as they come into the lab from the field. This designation for each sample analyzed is placed on the SMP EDD along with the date the sample arrived in the lab. The lab also adds to the SMP EDD the Lab Project Number and the Rohm and Haas Purchase Order Number under which the analyses are being performed.

"Lab" Quality Control Samples

The following sample types relate to Quality Performance in the "Field" and are covered under the heading of "Field Quality Control Samples".

Field Duplicates	Equipment Blanks
Field Blanks	Rinse Waters
	Well Construction Materials

The following naming conventions will be used to generate unique sample codes to identify Lab Quality Control Samples. These designations will be used in each of the EQuIS Imports, CRG SMP, CRG TRSQC, and CRG BAT, to describe and track the measured analytical results associated with these samples.

Trip Blanks

Trip Blanks are labeled with the date, site code, and the designation “TB”.

20020103LTGTB

When there is more than one trip blank for a given day, a unique sequence number should be added.

20020103LTGTB-1

Blind Samples:

In some cases a sample, for QA/QC purposes, will have to be submitted to the lab with a "blind" sample code. The blind code must be unique and the field staff must make an entry in their field logbook cross-referencing this blind code with the correct CRG sample code for that sample. When the results return from the lab, the cross-reference will allow them to enter the the results into the database under the correct CRG sample code rather than the blind code.

Matrix Spikes

A matrix spike sample is given the same code as the normal sample which is its parent except that the designation “MS” is used instead of “N”.

20020103MW-21V25MS

Note: When the work plan indicates that matrix spike and matrix spike duplicate samples are both to be taken, separate containers must be prepared by the lab for each of these samples. Past practice of using a single container to hold the material for both these samples has been discontinued and the sample type designation “MSD” eliminated.

Matrix Spike Duplicates

A matrix spike duplicate is given the same code as the normal sample which is its parent except that the designation “SD” is used instead of “N”.

20020103MW-21V25SD

Note: When the work plan indicates that matrix spike and matrix spike duplicate samples are both to be taken, separate containers must be prepared by the lab for each of these samples. Past practice of using a single container to hold the material for both these samples has been discontinued and the sample type designation “MSD” eliminated.

Lab Replicates

When the lab runs a replicate analysis on a sample, a new sample code is assigned to the sample which consists of the original sample code with the added ending “LR”.

Parent Sample Code

20020103MW-21V25N

Lab Replicate Code

20020103MW-21V25NLR

Method Blanks

The sample code is constructed using the convention of the lab doing the analysis followed by “MB”.

Normal Lab Code
04-12-03-564
Sample Code
04-12-03-564MB

Blank Spikes

The sample code is constructed using the convention of the lab doing the analysis followed by “BS”.

Normal Lab Code
04-12-03-564
Sample Code
04-12-03-564BS

Blank Spike Duplicates

The sample code is constructed using the convention of the lab doing the analysis followed by “BSD”.

Normal Lab Code
04-12-03-564
Sample Code
04-12-03-564BSD

Lab Control Samples

The sample code is constructed using the convention of the lab doing the analysis followed by “LCS”.

Normal Lab Code
04-12-03-564
Sample Code
04-12-03-564LCS

Surrogates

Surrogates are reported along with the results for a sample and therefore fall under the sample code of that sample. The Surrogate result type is designated as “SUR” and the surrogate recoveries are reported in the QC results section, not in the sample analytical results section.

Internal Standards

Internal Standards are reported along with the results for a sample and therefore fall under the sample code of that sample. The Internal Standard result type is designated as “IC” and the measured values are compared to the Standard in the QC results section, not in the sample analytical results section.

Chain of Custody (COC) Form Identifiers

Each page of the COC form should contain a unique Identifier for that Form clearly indicated on the Form. The following identifier format is recommended.

YYYYMMDDLabCOC-X

where X is a sequential number unique on that day (e.g., 1, 2, 3, etc.) “YYYY”=four-digit year, “MM”=two-digit month, and “DD”=two-digit day, and "Lab" is the Lab Code for the Lab doing the analyses.

“YYYYMMDD” represents the date on which the samples were packaged and shipped or relinquished to the LAB The sequential number is used to indicate the number of forms (pages) prepared on a single day

For two Containers going to the STL Lab in Edison on 3 February 2002

20020203STL-EDCOC-1

20020203STL-EDCOC-2

Cooler Identification Code

Each Container that carries samples to the analytical laboratory should have a unique container code and that code should appear on the Chain of Custody. Any convention is acceptable so long as the Identifier is unique. The following format is suggested.

YYYYMMDDLabBOX-Z

where Z is a sequential number unique on that day (e.g., 1, 2, 3, etc.) "YYYY"=four-digit year, "MM"=two-digit month, and "DD"=two-digit day, and "Lab" is the Lab Code for the Lab doing the analyses.

"YYYYMMDD" represents the date on which the container was packaged and shipped to the Lab The sequential number is used to indicate the number of the cooler prepared on the same day

For two Containers going to the STL Lab in Edison on 3 February 2002

20020203STL-EDBOX-1

20020203STL-EDBOX-2

Table 1

Sample Type Codes

Code	Description
AB	Ambient Conditions Blank
D	Dissolved (indicates filtered sample)
EB	Equipment Blank (rinse water after washing)
FB	Field Blank
FD	Field Duplicate
FR	Field Replicate
FS	Field Spike
MB	Material Blank (for background, baselines)
MS	Matrix Spike
N	Normal Environmental Sample
P	Preserved Sample (when normally unpreserved)
RD	Regulatory Duplicate; Split
RW	Rinse Water (before washing equipment)
SD	Matrix Spike Duplicate
TB	Trip Blank
U	Unpreserved Sample (when normally preserved)

Table 2

Rohm and Haas Site Codes

ACM	ACIMA SWITZERLAND
AMF	AMERSFOORT NETHERLANDS
ANJ	ANJOU QUEBEC
AWP	ANTWERP BELGIUM
API	APIZACO MEXICO
VA	ARLINGTON VA
GRC	ATHENS GREECE
NZL	AUCKLAND NEW ZEALAND
THA	BANGKOK THAILAND
BAR	BARCELONA SPAIN
BRQ	BARRANQUILLA COLOMBIA
BEI	BEIJING CHINA
BEJ	BERHC
BLM	BLOOMINGDALE IL
BOG	BOGOTA COLOMBIA
BMB	BOMBAY INDIA
BRM	BREMEN GERMANY
BRB	BRISBANE AUSTRALIA

BR	BRISTOL PA
BRS	BROSSARD QUEBEC
BUD	BUDAPEST HUNGARY
ARG	BUENOS AIRES ARGENTINA
CAL	CALGARY ALBERTA
AUS	CAMBERWELL AUSTRALIA
CAP	CAPE CANAVERAL FL & BAHAMAS
CAS	CASTRONNO (VARESE) ITALY
CTC	CHARLOTTE TECH CNT
CNY	CHAUNY FRANCE
TWN	CHIAYI HSIEN TAIWAN
CHW	CHIC HTS WHSE
CHT	CHICAGO HTS PLANT
KIL	CHICAGO IL - KILBOURN
CGO	CHICAGO IL - RIVERSIDE
CIC	CICERO IL
CIP	CILEGON INDONESIA
CIN	CINCINNATI OH
CLK	CLARKSON ONTARIO
DMK	COPENHAGEN DENMARK
COR	CORNATION CAN
CED	CORP ENG BRISTOL
CRY	CROYDON ENGLAND
CRO	CROYDON PA
DAY	DAYTON OH
HOU	DEER PARK TX
DFZ	DELFZJIL NETHERLANDS
DET	DETROIT MI
DEW	DEWSBURY ENGLAND
ME	DUBAI MIDDLE EAST
ELK	ELK GROVE IL
ELM	ELMA WA
ELS	ELSTON PLANT CHICAGO
HON	FAR EAST HONG KONG
FSN	FOSHAN CHINA
FRK	FRANKFURT GERMANY
FRE	FRESNO CA
GRL	GARLASCO ITALY
GTL	GEELONG AUSTRALIA LAB
GEE	GEELONG AUSTRALIA PLT
GLN	GLENDALE AZ
SAL	GRAND SALINE TX
GRM	GRANGEMOUTH SCOTLAND
GRT	GRANTSVILLE UT
GRV	GREENVILLE SC
GDL	GUADALAJARA MEXICO
HAY	HAYWARD CA

HO	HOME OFFICE PHILA
HUT	HUTCHINSON KS
ILE	ILES-DE-LA-MADELEINE QUEBEC
TUR	ISTANBUL TURKEY
JAC	JACAREI BRAZIL
JKT	JAKARTA INDONESIA
JCC	JAPAN ACRYLIC CHEM
JAR	JARROW ENGLAND
KNK	KANKAKEE IL
PAK	KARACHI PAKISTAN
KNX	KNOXVILLE TN
LMI	LA MIRADA CA
BAY	LA PORTE TX
LDK	LANDSKRONA SWEDEN
LAN	LANSING IL
LSP	LAS PINAS PLT PHILIPPINES
LTG	LAUTERBOURG FRANCE
LIN	LINDBERGH ALBERTA
LST	LONE STAR PLANT
LGB	LONG BEACH CA
LA	LOS ANGELES CA
LVL	LOUISVILLE KY
LOU	LOUISVILLE KY
MAL	MALAYSIA
PHN	MANILA PHILIPPINES
MAN	MANISTEE MI
MDL	MEDELLIN COLOMBIA
MEM	MEMPHIS TN
MEX	MEXICO CITY MEXICO
MIL	MILAN ITALY
MWK	MILWAUKEE WI
MGV	MONTGOMERYVILLE PA
MOS	MOSCOW RUSSIA
MSP	MOSS POINT MS - EM
MSS	MOSS POINT MS - P2
MOZ	MOZZANICA ITALY
MZZ	MOZZATE ITALY
CHI	MT. PROSPECT IL
IND	MUMBAI INDIA
NAN	NANTONG CHINA
WEK	NEW IBERIA LA (WEEKS)
NWK	NEWARK CA
NTF	NEWTOWN PA FARM
AND	NORTH ANDOVER, MA
CLE	NORTH OLMSTED OH
OJB	OJIBWAY ONTARIO
ORR	ORR ROAD NC

OSA	OSAKA JAPAN
FRP	PAINESVILLE OH (FAIRPORT)
PAR	PARIS FRANCE
PRN	PARONA ITALY
PAT	PATERSON, NJ
CMP	PAULINIA BRAZIL
PER	PERTH AMBOY NJ
PHL	PHILADELPHIA PA
PLT	PLANT CAN
PTE	POINTE CLAIRE QUEBEC
PUG	PUGWASH NOVA SCOTIA
QPU	QINGPU PLANT
RED	READING PA
FLY	READING PA (FLYING HILLS)
REG	REGINA SASKATCHEWAN
RGW	RINGWOOD IL
RIT	RITTMAN OH
ROB	ROBECHETTO ITALY
RCH	ROCHESTER HILLS MI
RDL	RODEL INC
ROM	ROMANO D'EZZELINO ITALY (PULVERLAC)
ROS	ROSWELL GA
SLC	SALT LAKE CITY LIT
COS	SAN JOSE COSTA RICA
CHL	SANTIAGO CHILE
BRA	SAO PAULO BRAZIL
SMY	SEMOY FRANCE
KOR	SEOUL SOUTH KOREA
SHA	SHANGHAI CHINA
GCT	SHANGHAI CHINA (GCTC)
SER	SHANGHAI EAST RH CO
SHP	SHIPLEY
SFE	SHIPLEY FAR EAST - TOKYO
SVL	SILVER SPRINGS NJ
SNG	SINGAPORE (NAC)
SGP	SINGAPORE (PLANT)
STC	SINGAPORE TECH CNT
SMA	SOMA PLANT JAPAN
SOA	SOUTH AFRICA
SPB	SPARTANBURG SC
SH	SPRING HOUSE PA
STL	ST LOUIS MO
STP	ST PAUL MN
STR	STRULLENDORF GERMANY
SYD	SYDNEY AUSTRALIA
TAI	TAIPEI TAIWAN

TYO	TOKYO JAPAN
TOL	TOLUCA MEXICO
TOY	TOYO MRTN-TOKYO JAPAN
TUD	TUDELA SPAIN
TUS	TUSTIN CA
MTN	UNASSIGNED LOCATION CODES
VLB	VALBONNE FRANCE
VNA	VIENNA AUSTRIA
VSP	VILLERS ST. PAUL FRANCE
WTX	WALLER TX
WAR	WARRINGTON ENGLAND
WRS	WARSAW IN
ALX	WEST ALEXANDRIA OH
WH	WEST HILL ONT CAN
DEL	WILMINGTON DE
WIN	WINDSOR ONTARIO
WOB	WOBURN MA
WST	WOODSTOCK, IL
WYV	WYTHEVILLE VA
NG	Y NAGOYA JAPAN
ZRT	ZARATE ARGENTINA

APPENDIX E – HEALTH AND SAFETY PLAN

SEE VOLUME II (APPENDIX E – HEALTH AND SAFETY PLAN, VERSION 2.0) OF REMEDIAL ACTION WORKPLAN SUBMITED ON JANUARY 15, 2007